

**U.S. MARINE CORPS
STYLE GUIDE**



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FOREWORD

This document is a description of the approved format and procedures to be followed in the development of U.S. Marine Corps equipment/system technical manuals. The style guide covers: (1) mechanical equipment manuals; (2) engineer, ordnance, and motor transport equipment manuals; (3) electronics equipment manuals; and (4) systems manuals. It also provides format and procedures for developing equipment technical manuals for operator through depot maintenance (1st through 5th Echelons).

The style guide is organized in parts. Each part covers a topic important to manual preparation, such as writing style, front matter pages, and technical content requirements. Referenced illustrations appear at the end of the part to which they pertain.

The format used to prepare the style guide was selected for ease of usage and is not intended as an example of format specifications for technical manuals.

PART I. INTRODUCTION

This guide explains the general style, format, and content requirements for preparing Marine Corps technical manuals. It covers the following kinds of equipment, manual compositions, and maintenance echelons:

Type IA.	Mechanical Equipment	1-1.	EQUIPMENT
Type IB.	Engineer, Ordnance, and Motor Transport Equipment		
Type II.	Electronics Equipment		
Type III.	Systems.		
-10.	Operator's Manual	1-2.	MANUAL COMPOSITIONS
-12.	Operation and Maintenance Manual		
-13.	Operation and Maintenance Manual		
-14.	Operation and Maintenance Manual		
-15.	Operation and Maintenance Manual		
-20.	Maintenance Manual		
-23.	Maintenance Manual		
-24.	Maintenance Manual		
-30.	Maintenance Manual		
-34.	Maintenance Manual		
-40.	Maintenance Manual.		
First Echelon.	Maintenance performed by the user or operator.	1-3.	MAINTENANCE ECHELON DEFINITIONS
Second Echelon.	Maintenance performed by specially trained personnel in the using organization.		
Third Echelon.	Maintenance performed in direct support of, or in some specifically authorized cases by, the using unit.		

Fourth Echelon. Maintenance performed in rear areas by a higher echelon than the maintenance organization directly supporting the using unit, or in some specifically authorized cases, by the using unit.

Fifth Echelon. Maintenance performed at a depot which embraces major overhaul or complete rebuilding of parts, subassemblies, assemblies, or the end item.

1-4. APPLICABLE DOCUMENTS

The documents listed below provide additional information on style, format, and content requirements of technical manuals. Refer to the Department of Defense Index of Specifications and Standard (DoDISS) specified in the solicitation to determine which issue of these documents is in effect.

1-4.a. Specifications

a. Specifications.

MIL-P-116	Preservation, Methods of
MIL-D-1000	Drawings, Engineering and Associated Lists
MIL-M-8910	Manual, Technical, Illustrated Parts Breakdown, Preparation of
MIL-M-15071	Manuals, Technical: Equipment and Systems, Content Requirements for
MIL-L-22690	Lubrication Charts, Plates, and Manuals, Preparation and Production of
MIL-I-28947A(MC)	Illustrations for Technical Repair Parts Publications: Preparation of
MIL-M-38784	Manuals, Technical: General Style and Format Requirements

MIL-P-38790	Printing Production of Technical Manuals; General Requirements for
MIL-M-38807	Manual, Technical, Illustrated Parts Breakdown, Preparation of.

b. Standards.**1-4.b. Standards**

MIL-STD-12	Abbreviations for Use On Drawings, Specifications, Standards and in Technical Documents
MIL-STD-17-1	Mechanical Symbols (other than Aerospacecraft, and Spacecraft Use) (Part I)
MIL-STD-17-2	Mechanical Symbols for Aeronautical, Aerospace, and Spacecraft Use (Part II)
DoD STD-100	Engineering Drawing Practices.

c. Publications.**1-4.c. Publications****(1) Military.**

DoD 5200.1-R	Information Security Program Regulations
DoD 5200.22-M	Industrial Security Manual for Safeguarding Classified Information
FM 5-25	Explosives and Demolitions
SL-4	Marine Corps Stocklist

(2) United States of America Standards Institute (USASI).

X3.5	Flowchart Symbols and their Usage in Information Processing
Y14.15	Electrical and Electronics Diagrams
Y32.2	Graphic Symbols for Electrical and Electronics Diagrams, (Including Reference Designation Class Designation)
Y32.10	Graphic Symbols for Fluid Power Diagrams, Including Supplements
Y32.14	Logic Diagrams; (Two-State Devices) Graphic Symbols for
Y32.16	Reference Designations for Electrical and Electronics Parts and Equipments.

(3) Other.

U.S. Government Printing Office Style Manual

1-4.d. Orders

d. Orders.

Marine Corps Order (MCO) 4400.32D	Policy for Logistics Support of New Equipment Introduced Into the Marine Corps
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e. Handbooks.

1-4.e. Handbooks

- H4-1 Cataloging Handbook, Federal Supply code for Manufacturers, United States and Canada, Name to Code
- H4-2 Handbook, Federal Supply Code for Manufacturers, United States and Canada, Code to Name
- H6-1 Federal Item Name Directory for Supply Cataloging.

When a conflict occurs between this style guide and the documents referenced above, this style guide takes precedence. When a conflict occurs between this style guide and the contract, the contract takes precedence.

1-5. CONFLICT
BETWEEN
DOCUMENTS

Technical manual products must conform to contract requirement and the format specifications of MIL-M-38784. The kinds of manual products are explained below:

1-6. TECHNICAL
MANUAL
PRODUCTS

- a. Basic Manual. The basic manual refers to the original manual edition.
- b. Preliminary Manual. This manual is an interim issue that a contractor submits to the procuring agency for review and approval before developing the final manual. It will normally be used for overpack with end item.
- c. Draft Manual. The draft manual is reviewed and accepted for verification by the procuring agency prior to issuance of the preliminary manual.

1-6.a. Basic Manual

1-6.b. Preliminary
Manual

1-6.c. Draft Manual

1-6.d. Commercial Manual

d. Commercial Manual. A commercial manual may be supplemented to supply missing data and must meet the requirements of MIL-M-7298. If still unacceptable, the procuring agency will direct the contractor to prepare a military technical manual according to government specifications.

1-6.e. Commercial-Off-The-Shelf Manual

e. Commercial-Off-The-Shelf. A commercial-off-the-shelf manual is different from the commercial manual in that it is a manufacturer's existing manual. Commercial-off-the-shelf manuals contain technical information on assembly, installation, operation, servicing, overhaul, and parts identification. These manuals are furnished to equipment buyers.

1-6.f. Supplemental Manual

f. Supplemental Manual. A supplemental manual complements the data provided in a basic manual. It is used to present data on a unit or assembly to be added to equipment without modifying the original equipment.

1-6.g. Revisions

g. Revisions. These are second or later manual editions and volumes that supersede a previous edition. Revisions are required when the number of corrected and updated pages is more than 25 percent of the total manual. See MIL-M-38784 on the preparation of manual revisions.

1-6.h. Change Pages

h. Change Pages. A change is comprised of corrected pages to the basic manual. It consists of information that improves or clarifies the basic manual without rewriting or reorganizing the technical content of the basic manual. Changes to an existing manual shall be issued in the form of replacement pages when the number of corrected and updated pages is

less than 25 percent of the total manual. See MIL-M-38784 on the preparation of replacement or change pages.

PART II. WRITING STYLE

Writing style is one of the most important points to consider when putting together a technical manual. The following guidelines will help to ensure effective communication.

Use simple words and phrases to communicate with the reader. Do not use ambiguous terms. Keep terms consistent within each manual.

2-1. CLARITY

Well planned word order needs minimal punctuation. Keep sentences short and concise. Rewrite sentences requiring extensive punctuation. Do not use quotation marks and underscoring for emphasis. See the U.S. Government Printing Office Style Manual for specific information on punctuation.

2-2. PUNCTUATION

Chapter, section, and paragraph headings must clearly describe the contents of the division they head. Use "general" and "miscellaneous" only when no other title will do.

2-3. HEADINGS

Use "shall" to express a binding provision. Use "should" and "may" to express non-mandatory provisions. Use "will" to express a declaration of purpose.

2-4. USE OF SHALL WILL, AND MAY

Make no reference to age, sex, race, or national origin. Use sex neutral terms, but avoid the use of the word "person" as in "lineperson."

2-5. NON- DISCRIMINATORY LANGUAGE

Keep abbreviations to a minimum. When used, define abbreviation the first time it appears in a chapter. If the composing equipment cannot produce a "+" for "plus or minus," use "POM." Explain new abbreviations in the glossary. See MIL-STD-12 for more specific information on the use of abbreviations.

2-6. ABBREVIATIONS

2-7. READING LEVEL

Consult the procuring agency if the contract does not contain specific information on reading level. The following are general guidelines:

- a. Write chapter one summary portions at the level of command and supervisory personnel.
- b. Write operating instructions at the level of an operator with past experience operating similar equipment.
- c. Write remaining manual portions at the level of the least technically skilled technician who will be using the manual for training, operation, or maintenance.
- d. The method of determining readability is optional. However, it must meet the quality assurance provisions in MIL-M-38784. Appendix A to this document contains an acceptable readability scale.

2-8. WARNINGS AND CAUTIONS

Prepare warnings and cautions in accordance with MIL-M-38784 and as follows:

- a. Use warning statements in the body of the text to call attention to steps and procedures that must be strictly followed to prevent serious injury or death to personnel.
- b. Use caution statements in the body of the text to call attention to steps and procedures that must be strictly followed to prevent damage to, or destruction of, equipment.
- c. Give the consequence of failure to adhere to a warning or caution.
- d. Limit the use of warning and caution statements to significant cases. Overuse will decrease the extent of emphasis.
- e. Do not place procedural steps in warning and caution statements.

Prepare notes in accordance with MIL-M-38784 and as follows:

2-9. NOTES

- a. Use notes in the body of the text to present narrative or explanatory, non-procedural data.
- b. Do not use notes with, or in place of, procedural steps.
- c. Make notes short and concise.

PART III. FORMAT

Format must facilitate the comprehension of text, illustrations, and tables. Prepare format according to MIL-M-38784 and the specifications of this document.

The hierarchial breakdown of a manual is volumes, parts, chapters, sections, and paragraphs, as appropriate. There must be two of each subdivision used. When there is a volume 1, there must be a volume 2. When there is a part one, there must be a part two, etc. Title all volumes, parts, chapters, section, and numbered paragraphs. Do not title procedural steps or statements following a colon. Plan breakdown to subordinate the appropriate information.

3-1. DIVISIONS

Use the following breakdown for numbering paragraphs:

3-2. PARAGRAPH NUMBERING

- a. 1-1
- b. 1-1 a
- c. 1-1 a (1)
- d. 1-1 a (1) (a)
- e. 1-1 a (1) (a) 1
- f. 1-1 a (1) (a) 1 a

Assign even numbers to left-hand pages and odd numbers to right-hand pages. Indicate chapter number as well as page number. For example, chapter 3, page 2, would read "3-2" on the lower left-hand page. To number a blank page, place the blank page's number on the preceding page. Follow the preceding page's number by a slash with the blank page number in parenthesis. For example, if page 2-4 was a blank page, page 2-3 would read "2-3/(2-4 blank)."

3-3. PAGE NUMBERING

3-4. CHAPTER NUMBERING Use Arabic numerals to number chapters. Use Roman numerals to number sections. Appendices B and C contain a chapter format summary arrangement for technical manual types IA, IB, II, and III and -10 through -40.

3-5. PAGE POSITIONING Begin table of contents, safety summary, parts, chapters, appendices, and the alphabetical index on a right-hand page.

3-6. HEADINGS Center numbers and titles for parts, chapters, sections, appendixes, alphabetical index, etc. at the top of the first page of text for each. Center the Section I heading immediately below the chapter heading. Center subsequent section headings on the page preceding the applicable text.

3-7. CAPITALIZATION Use the following guidelines for capitalization:

3-7.a. Center Headings

- a. Center Headings. Capitalize every letter of every word except for "Section," for example:

CHAPTER I
INTRODUCTION
Section I. GENERAL INFORMATION

3-7.b. Side Headings

- b. Side Headings. Capitalize every letter in the primary side heading. Capitalize first letter of each word in subordinate side headings, for example:

1-1. PRIMARY HEADING.

- a. First-Level Subparagraph.

- (1) Second-Level Subparagraph.

- (a) Third-Level Subparagraph.

-
- c. Illustrations and Tables. Capitalize first letter of each word in titles of illustrations and tables.
 - d. Table of Contents. Capitalize first letter of each word in paragraph titles in the table of contents.

- 3-7.c. **Illustrations and Tables**
- 3-7.d. **Table of Contents**

Do not exceed a three inch thickness or 500 pages on single volume manuals. When thickness exceeds three inches, bind Chapter 4 (manual types I and II) or Chapter 5 (manual type III) separately. When three or more volumes are necessary for a three inch thickness or 500 pages per volume, bind one or more additional chapters separately in the following order:

- 3-8. **VOLUMES**

- a. Schematics/Circuit diagrams
- b. Parts list
- c. Introduction
- d. Scheduled maintenance
- e. Troubleshooting.

Include the following distribution statement on the cover and title page of final manuals:

- 3-9. **DISTRIBUTION**

"This publication is required for official use or for administrative or operational purposes only. Distribution is limited to U.S. Government agencies. Other requests for this document must be referred to Headquarters, U.S. Marine Corps, Code HQSP-2, Washington, D.C. 20380-0001."

Prepare illustrations in accordance with MIL-M-38784, MIL-I-28947A(MC), and this style guide. As a general rule, use line drawings instead of photographs. When photographs must be used, make them detailed and sharp, and free of heavy shadows and clutter. Establish good contrast between white, middle tones, and black. Illustrations should follow reference in text as closely as possible.

- 3-10. **ILLUSTRATIONS**

3-10.a. Callouts

- a. Callouts. Use consecutive Arabic numerals to identify individual items and parts in illustrations. Typeset callouts or prepare them mechanically. Order numerals from top to bottom or clockwise, when possible. See figure 3-1.

3-10.b. Legends

- b. Legends. Include a legend on each illustration that contains the numerical listing of callouts and their identification. Zone illustrations with callouts for more than 100 parts. See figure 3-1.

3-11. TABLES/CHARTS

Present reference data in tabular, chart, or graph form. Assign figure numbers for charts and graphs. If charts and graphs contain only a small amount of tabulated information, they may be included in a paragraph of text.

**3-12. ILLUSTRATION
CUTLINES**

In a preliminary manual, use cutlines to show figure placement in the text. Place these at the end of the first paragraph to which they pertain. Center the figure number and title below the figure. Leave a 1½ inch space above and below the cutline. See figure 3-2.

**3-13. FIGURE
TITLES**

Place figure title after the assigned figure number. Center the title below the applicable illustration. Example: Figure 2-42. Interconnector Box.

**3-14. TABLE
TITLES**

Place table title after the assigned table number. Center the title above the applicable chart or table. Example: Table 4-3. Scheduled Maintenance Action Index.

**3-15. CONTINUED
MATERIAL**

Repeat the number and title of a table or chart continued on a following page. Follow the title with "(Continued)." Place this information at the head of the columns on all following pages. See figure 3-3.

Follow these format requirements when preparing warnings and cautions:

3-16. WARNINGS AND CAUTIONS

- a. Do not number warning or caution statements and do not include procedural steps.
- b. Prepare short and concise warnings and cautions and only emphasize important or critical data.
- c. Positively or negatively word warnings and cautions and state hazard and result or reason, unless obvious.
- d. When a warning or caution contains more than one paragraph, do not repeat the heading "WARNING" or "CAUTION" above each paragraph.
- e. Indent warning and caution statements in order to visibly differentiate the statements from any other text.
- f. If it is necessary to precede a paragraph by both a warning and a note or a caution and a note, etc., warnings shall precede cautions, which in turn shall precede notes. See figure 3-4.

Follow these format requirements when preparing notes:

3-17. NOTES

- a. Do not number notes.
- b. Indent and capitalize to set off notes.
- c. Place notes after warning or caution statements.

Prepare references according to MIL-M-38784 and this style guide:

3-18. REFERENCES

- a. References Between Diagrams. Reference by figure number. Include sheet and zone numbers for multi-sheet and zoned diagrams.
- b. References in Text. Reference all illustrations, tables, and charts in the text. When referring to

- 3-18.a. References
Between
Diagrams**
- 3-18.b. References
In Text**

multiple sheet figures, include the sheet number(s) in the reference, for example: "See figure 4-6, sheet 3."

3-18.c. Paragraph References

- c. Paragraph References. For single volume manuals, use paragraph numbers to reference text. For multi-volume manuals, use volume number and paragraph number to reference text.

**3-18.d. Reference
Placement**

- d. Reference Placement. Use the following format for reference placement:

- (1) When the reference applies to one item in a sentence, place the reference in parentheses immediately after the item.
- (2) When the reference applies to an entire sentence, place the reference at the end of the sentence.
- (3) When the reference applies to entire paragraph(s), place the reference after the paragraph head.
- (4) When referencing items in figures by reference designations, indicate item number as well as figure number.

3-19. DIAGRAM ZONING

Zone diagrams containing callouts for more than 100 parts according to MIL-M-38784 and as follows:

3-19.a. Horizontal Zones

- a. Horizontal Zones (Ordinates). Divide diagrams into equally spaced horizontal zones, designated by alpha characters (i.e., A, B, and C). Place designations from bottom to top along the outside left and right borders.

3-19.b. Vertical Zones

- b. Vertical Zones (Abscissa). Divide diagrams into equally spaced vertical zones designated 1, 2, 3, etc. Place designations from right to left along the outside top and bottom borders.

3-19.c. Zone Size

- c. Zone Size. Make zone size large enough to clearly locate referenced points.

-
- d. Circuit Elements. Include the location of all circuit elements by zones in a table on the apron.
 - e. Reference Format. When referencing zones, list the Arabic numeral first to avoid confusion with text reference designations.

3-19.d. Circuit Elements**3-19.e. Reference Format**

Prepare diagram notes according to MIL-M-38784 and the following specifications:

3-20. DIAGRAM NOTES

- a. Placement. Confine diagram notes to clear spaces of the image area. Place notes for foldout diagrams on the apron (except for installation control drawings). Identify notes with the legend "GENERAL NOTES" and "SPECIFIC NOTES," as applicable.
- b. General Notes. These apply to the entire diagram and appear only on the first sheet of multi-sheet diagrams. Make no reference to general notes from the diagram or from specific notes. Place general notes before specific notes. Use capital letters (A,B,C, etc.) to identify general notes.
- c. Specific Notes. These apply only to a specific item on a diagram. Repeat specific notes on each sheet of a multi-style sheet diagram to which they apply. It is not necessary to refer to a specific note on another sheet of a diagram. Place specific notes after general notes. Use Arabic numerals (1,2,3, etc.) to identify specific notes.

3-20.a. Placement**3-20.b. General Notes****3-20.c. Specific Notes**

Place apron notes for foldout diagrams in a final size image area of 7 to 10 inches. Make letter height a minimum of 0.060 inches. Arrange notes to make best use of available space. When notes for a given diagram foldout sheet require more than a 7 x 10 inch apron, extend notes to the

3-21. APRON NOTES

diagram image area. If there is not enough space in image area, begin notes on single pages preceding the foldout diagram. Start notes on the first additional sheet. Print sheet as a right hand page. Both sides of the page may be used. Do not use a foldout sheet for running text. Show the figure number, title, and sheet number, on each sheet of the diagram, including note sheets.

**3-22. MULTIPLE PAGE
NOTES**

If used with illustrations, number these consecutively front and back. Do not delineate multiple page notes as being part of an overall note page. Delineate illustrations as being sheet ___ of ___, of an overall illustration, as applicable. Place notes before the illustration or on the illustration apron, as applicable. Make note pages single sheet type.

3-23. FOLDOUT PAGES

Prepare foldout pages only when approved by the procuring agency. If approved, foldout pages may be prepared for the 4 by 8 inch, 5 by 8 inch, and 8½ by 11 inch manuals. Do not use foldout pages in 4 by 5½ inch or 11 by 17 inch manuals. Prepare all foldout pages for printing on one side only. Use 8½ by 11 inch full blank aprons. Do not splice foldout pages. Place all foldout pages at the end of the chapter or document as specified by procuring agency. Foldout pages must follow the last chapter, last appendix, or alphabetical index, whichever forms the last portion of the manual or volume. See MIL-M-38784 for further information on the preparation of foldout pages.

3-24. RUNNING HEADS

Running heads are words and/or numbers or series of words and/or numbers (such as a title of a manual), often in larger letters placed at the top of the page. Include complete running heads on all pages of all volumes and parts.

-
- a. Security Classification. When required, place the security classification, including unclassified pages, at the top and bottom center of each page and 8½-inch segment of foldouts. Mark unclassified back-up pages of classified data with the security classification of the classified data. Place the following statement at the top of the unclassified page: "The data for this page is unclassified."
 - b. Technical Manual Identification Number. Place this number at the top right-hand corner of each right-hand page. For left-hand pages, place this number at the top left-hand corner. The number must also appear on the upper outside corner of foldouts. Do not alter identification number on change pages.

Running feet are words and/or numbers or series of words and/or numbers, often in large letters placed at the bottom of the page. Include complete running feet on all pages of all volumes and parts.

- a. Page Numbers. For 8½ x 11 inch pages, place this number at the bottom right-hand corner of each right-hand page. For left-hand pages, place this number at the bottom left-hand corner. For 4 x 5½ inch, 4 x 8 inch, or 5 x 8 inch page size, see MIL-M-38784.
- b. Issue Indicator. The month and year will be placed at the lower right-hand corner of front cover.

See MIL-M-38784 for the page size of camera-ready text and artwork requiring no reduction photographically for printing. The contract will indicate the size in which a manual will be reproduced when 4 by 5½ inch, 4 by 8 inch, 5 by 8 inch, or 11 by 17 inch size is required. Otherwise,

3-24.a. Security Classification

3-24.b. Technical Manual Identification Number

3-25. RUNNING FEET

3-25.a. Page Numbers

3-25.b. Issue Indicator

3-26. PAGE SIZE AND REPRODUCTION AREA

use 8½ by 11 inch size. Manuals measuring 4 by 5½ inches must not exceed 200 pages. Manuals measuring 8½ by 11 inches must not exceed 500 pages.

3-27. QUALITY ASSURANCE

See MIL-M-38784 for information on quality assurance.

**3-28. PREPARATION
FOR DELIVERY**

Prepare manuals for delivery according to the following guidelines unless otherwise specified in the contract or order.

3-28.a. Manuscripts

- a. Manuscripts. Package manuscripts flat in cartons or wrap them separately. Elaborate containers are unnecessary. Separate artwork and text material into one package or separate packages. Copies of large artwork to be used for review purposes only may be unfolded. Packaging need only be adequate for providing safe delivery and for providing protection against forms of damage that frequently occur during shipping.

**3-28.b. Camera-Ready
Copy**

- b. Camera-Ready Copy. Do not fold or roll artwork. Camera-ready copy must be flat and double-packaged. The interior material must be waterproof and free of any chemical substance that would discolor or otherwise harm the reproducible copy. The exterior package must be a standard commercial carton at least equal to Interstate Commerce Standards and of sufficient strength to provide safe delivery, and to protect the camera-ready copy against forms of damage that frequently occur during shipping.

**3-28.c. Classified
Material**

- c. Classified Material. Package classified material in accordance with DoD 5200.1-R or DoD 5200.22-M as applicable.

**3-28.d. Original
Artwork**

- d. Original Artwork. Package original artwork as specified in the contract or order.

-
- e. Package Information. In addition to sender and addressee information, the exterior of each package must specify the following:

- (1) Publication identification number
- (2) Contract or purchase order number
- (3) "Manuscript," when applicable
- (4) "Camera-Ready Copy," when applicable
- (5) Number of packages in shipment.

**3-28.e. Package
Information**

- f. Packing List. Place a copy of the letter of transmittal, DD 250, as applicable, or the packing list inside the package. When a shipment consists of several packages, enclose the letter of transmittal or packing list in the first package. Identify the material that was wrapped in each package.

3-28.f. Packing List

Arrange manual parts in the following order:

- a. Front matter
- b. Technical content
- c. Appendices
- d. Index

**3-29. MANUAL
ORGANIZATION**

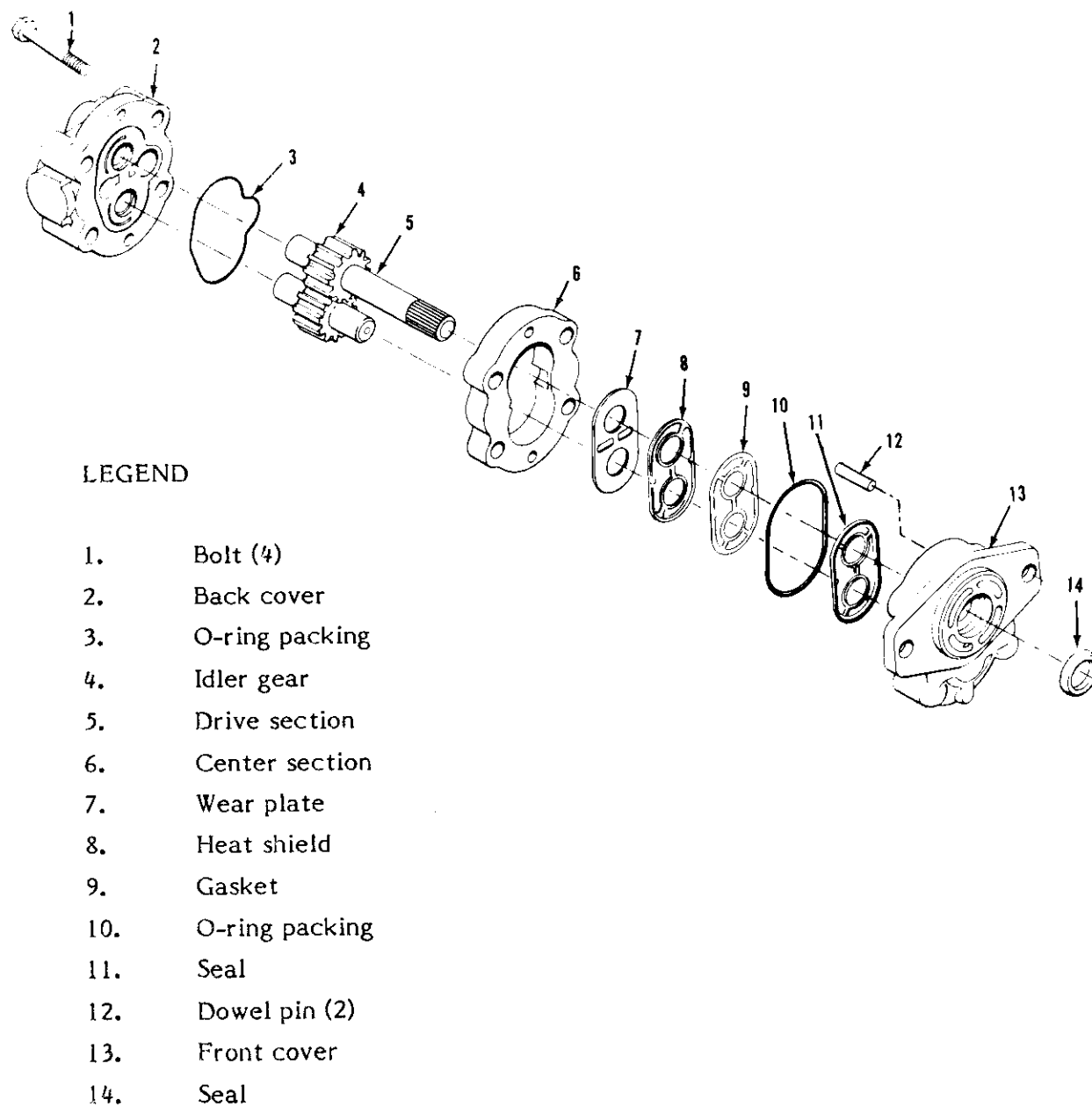


Figure 3-1. Sample of Callouts

b. AC Power Relays. (See figure 3-3.) Two AC power relays, a voltage sensitive relay, and a contractor relay are mounted in a hinged panel box assembly directly above the power panel. They are non-repairable items.

1½ inch

Cutline

Figure 3-3. AC Power Relays

Cutline

1½ inch

(1) Relay Removal.

(a) Ensure power is OFF by placing the main power transfer switch to the center OFF position and disconnecting the power cable on the outside of the shelter.

(b) Loosen wing nuts holding the hinged panel closed. Swing panel open to the right.

(c) Tag and disconnect wires from the relay terminals.

(d) Remove relay mounting hardware.

(e) Remove relay.

(f) Retain relay mounting hardware for reuse.



Figure 3-2. Sample of Illustration Cutlines

Table 3-5. Fault Isolation Procedures, Teletypewriter Central, AN/TGC-46 Shelter, AC Power (Continued)

Item	Malfunction	Possible Cause	Corrective Action
4.	With main power evident and main power CB and A/C CB energized, air conditioner/heater will not energize.	<ol style="list-style-type: none"> 1. Faulty A/C CB. 2. Interface between power panel and A/C control. 3. Faulty A/C Control. 4. Interface between control and A/C. 	<ol style="list-style-type: none"> 1. Replace A/C CB. (See paragraph 3-11b.) 2. Check interface cabling, wiring and connectors and repair as necessary. (See FO-35.) 3. Repair or replace control. (See paragraph 3-11b.) 4. Check interface cabling, wiring, connectors. (See FO-35.)
5.	With all power evident Air conditioner/heater:		
	a. Compressor will not start.	<ol style="list-style-type: none"> 1. No power to air conditioner. 2. Selector switch improperly set. 3. Contacts of A/C circuit breaker open. 4. Contacts of high pressure cutout switch open. 5. Open control circuit. 6. Loose electrical connections or faulty wiring. 7. Defective circuit breaker. 8. Defective compressor motor. 	<ol style="list-style-type: none"> 1. Connect power, check power panel CB to A/C. (See paragraph 3-11a.) 2. Set selector switch to "COOL". (See paragraph 3-11a.) 3. Reset circuit breaker. (See paragraph 3-11a.) 4. Push reset button to reset switch. (See paragraph 3-11a.) 5. Make continuity check of circuit. Replace defective controls. (See FO-35.) 6. Tighten loose connections. Repair wiring if necessary. (See FO-35.) 7. Check circuit breaker. (See paragraph 3-11c.) 8. Check motor for open windings and grounds. (See FO-35.)

Figure 3-3. Sample of Continued Material

4-8. WATER HOSE ASSEMBLIES. Maintenance of water hose assemblies is accomplished at both organizational and intermediate maintenance levels. Inspection, removal, and replacement are accomplished at organization level. Disassembly and reassembly of water hose assemblies are accomplished at intermediate maintenance level.

a. Inspection. Inspect water hose assemblies (figure 3-9) for dirty, cracked, broken, collapsed, and deteriorated hose; for broken or missing clamps; and for broken, loose, or corroded quick disconnect couplings.

WARNING

**ENSURE THAT ELECTRICAL POWER IS REMOVED FROM WATER HEATER,
AND THAT WATER VESSEL IS COOL BEFORE HANDLING TO PREVENT INJURY
OR DEATH.**

CAUTION

**ENSURE THAT WATER PUMP IS TURNED OFF BEFORE ATTEMPTING TO
REMOVE WATER HOSES TO PREVENT DAMAGE TO EQUIPMENT.**

NOTE

**WHERE APPLICABLE, DEPRESS POT FILLER HANDLE TO RELIEVE WATER
PRESSURE IN HOSE BEFORE ATTEMPTING TO REMOVE WATER HOSE
ASSEMBLY.**

b. Removal. Disconnect water hose assemblies from water pump, water heater, and pot filler assemblies as applicable.

c. Replacement. Replace defective water hose assembly with a like, serviceable assembly. Connect new water hose assembly to water pump, water heater, and pot filler assemblies as applicable.

Figure 3-4. Sample of a Warning, Caution, and Note Within Text

PART IV. FRONT MATTER

Each manual must contain specific front matter pages. Place this material before the first page of manual text in the order listed below:

- a. Front Cover
- b. Microwave Warning Page, as applicable
- c. Warning Page, as applicable
- d. List of Effective Pages
- e. Change Record
- f. Table of Contents
- g. List of Illustrations
- h. List of Tables
- i. Safety Summary.

Each manual must have a front cover. Prepare front cover according to figure 4-1. See MIL-M-38784 for the preparation of front cover of classified and confidential material.

4-1. FRONT COVER

Include a microwave warning page, as applicable. Place this page on the reverse side of the cover page. See figure 4-2.

4-2. MICROWAVE WARNING PAGE

Include each general type of warning and warning symbol used within the technical manual. Do not present a list of specific warnings or specific procedural steps. Warning page may be placed on the reverse side of front cover if warnings are brief. See figure 4-3 for a sample warning page.

4-3. WARNING PAGE

Manual revisions must include a list of effective pages indicating which pages have been superseded. Include title page, list of effective pages, blank pages, deleted pages, added pages, and foldout pages in the list, as applicable. Update the list for each manual change. The list of

4-4. LIST OF EFFECTIVE PAGES

effective pages must be a right hand page. It should back up the title page or a separate transmittal page. Identify this page by the letter "A" in the lower, right hand corner of the page. Use alpha characters (i.e., B, C, and D) for subsequent pages. See figure 4-4.

**4-5. CHANGE
RECORD**

Provide a change record for each manual prepared in accordance with figure 4-5. Do not back up a change record with, or against, another page. Do not number change record pages.

**4-6. TABLE OF
CONTENTS**

All technical manuals must have a table of contents. In volume I of a multi-volume, provide a complete table of contents including list of illustrations and tables covering all volumes. Each remaining volume must also have its own table of contents listings. See figure 4-6 for a sample table of contents.

**4-7. LIST OF
ILLUSTRATIONS**

Provide a list of illustrations for any manual containing ten or more illustrations, including charts and graphs with assigned figure numbers. Show figure number, title, and page number of each figure. Indicate the security classification, if any, of illustration titles. In volume I, provide a complete list of illustrations for all volumes in a set. Each remaining volume must also have its own list of illustrations. See figure 4-7 for a sample list of illustrations.

**4-8. LIST OF
TABLES**

Provide a list of tables for any manual containing ten or more tables. Show the table number, title, and page number of each table. Indicate the security classification, if any. In volume I, provide a complete list of tables for all volumes in a set. Each remaining volume must also have its own list of tables. See figure 4-8 for a sample list of tables.

Include a safety summary in each volume of a set of manuals. Safety summaries must contain general safety information as well as all warnings and cautions appearing in the text including page number in text where stated. See figure 4-9 for sample safety summary.

**4-9. SAFETY
SUMMARY**

- a. General Safety Information. Give shop related, general safety information such as the toxicity of cleaning solvents. Do not repeat general safety precautions in the text if they are commonplace to the manual topic. However, if in doubt, place the general safety information in the text as a warning or caution. See paragraph 2-8 of this document.
- b. Warnings and Cautions. Rephrase warnings and cautions, if necessary, so that they can be understood out of context. Provide the page number on which each warning and caution appears.

**4-9.a. General Safety
Information**

**4-9.b. Warnings and
Cautions**

TYPE SIZE
IN POINTS

24 to 30

18 to 24
1

**TM 08610A-34
VOLUME I**

U.S. MARINE CORPS TECHNICAL MANUAL

24 to 30

**INTERMEDIATE
MAINTENANCE INSTRUCTIONS**

18 to 24

**TELETYPEWRITER CENTRAL
AN/TGC-46**

2 inch diameter



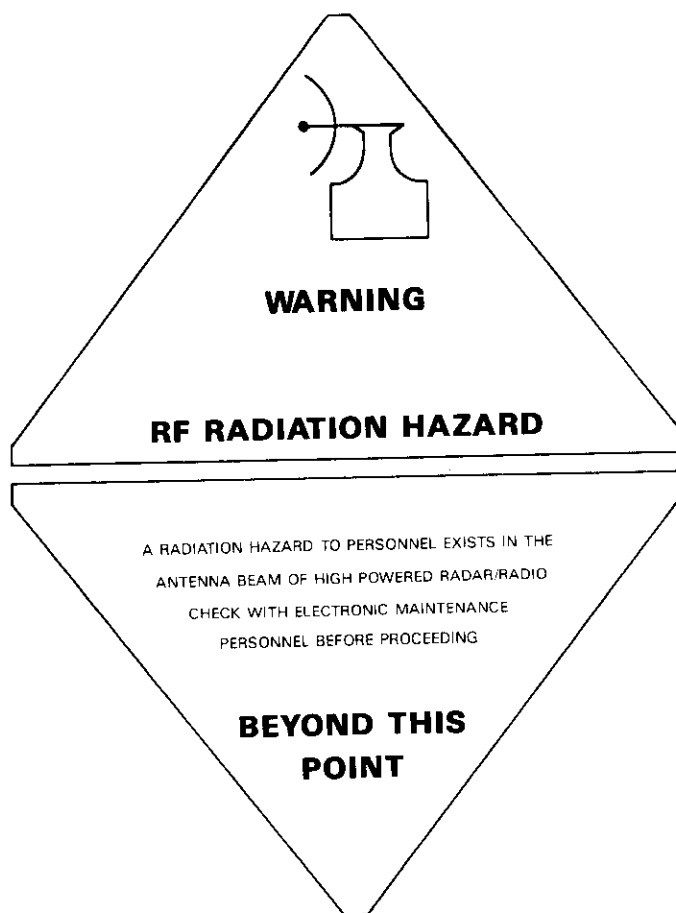
1
18 to 24

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TION OF THE DOCUMENT

FOR OFFICIAL USE ONLY **FEBRUARY 1985**

Figure 4-1. Sample of Front Cover



THIS WARNING SHALL BE LOCATED AT EYE LEVEL AND ON
ALL SIDES SURROUNDING THE ANTENNA AREA.

Typical Radiation Hazard Warning Sign

Figure 4-2. Sample of Microwave Warning Page



To look along the axis of a laser beam without protective glasses is extremely dangerous. Align the laser so that personnel are unlikely to inadvertently look along the axis of its beam.

Laser firing systems may store a charge. Take care to prevent accidental pulsing of the laser and to avoid electric shock. Systems should be so designed as to include a "fail-safe" means of avoiding this hazard.

Reflections from the laser beam are extremely dangerous. It is essential that all reflective material be removed from its path.

EXAMPLE G

Figure 4-3. Sample of Warning Page

Publication Number		TYPE SIZE IN POINTS																																																				
		18																																																				
		10																																																				
INSERT LATEST CHANGED PAGES. DESTROY SUPERCEDED PAGES.		8																																																				
LIST OF EFFECTIVE PAGES		14																																																				
NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margin of the page. Changes to illustrations are indicated by miniature pointing heads. Changes to wiring diagrams are indicated by shaded areas.		6																																																				
<p>Dates of issue for original and changed pages are:</p> <p>Original...0...3 Jan 66</p> <p>Change...1...10 Feb 66</p> <p>Change...2...15 May 66</p> <p>TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 92 CONSISTING OF THE FOLLOWING:</p>		8																																																				
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Figure 4-4. Sample of List of Effective Pages

PUBLICATION NUMBER

RECORD OF CHANGES

CHANGE NO.	DATE	TITLE OR BRIEF DESCRIPTION	ENTERED BY

Figure 4-5. Sample of Change Record

TABLE OF CONTENTS

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1-2. Description	1-1
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Figure 4-7. Sample of List of Illustrations

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Figure 4-8. Sample of List of Tables

SAFETY SUMMARY

The following **WARNINGS** and **CAUTIONS** appear on the page referenced and are listed here for emphasis.

WARNING

Do not use any fuel not specified. To do so can cause injury to personnel and damage to equipment. (page 1-7, 2-6)

WARNING

Have all personnel clear the area before lifting the water heater to prevent injury or death. (page 2-1)

WARNING

Do not connect water heater to untested water supply. Contaminated water can cause illness or death. (page 2-2)

CAUTION

To prevent damage to equipment, clean up area and dispose of all packing material. Do not leave nails and other debris scattered around area. (page 2-1)

CAUTION

Do not connect water heater directly to a pressurized water system. If such a source is used, empty water into open reservoir or tank, then draw water from tank using water pump. (page 2-3)

CAUTION

For proper equipment operation the 208 vac, 3-phase power source must be connected in a "y" configuration. (page 3-6)

Figure 4-9. Sample of Safety Summary

PART V. TECHNICAL CONTENT - TYPE IA. MANUALS (Mechanical Equipment)

The following pages explain the technical content of Type IA. manuals. Type IA. manual covers the installation, operation, maintenance, and repair of mechanical equipment.

Arrange the technical contents of the manual as follows:

5-1. CHAPTER HEADINGS

- a. Chapter 1. General Information and Safety Precautions
- b. Chapter 2. Installation
- c. Chapter 3. Functional Description
- d. Chapter 4. Operation
- e. Chapter 5. Scheduled Maintenance
- f. Chapter 6. Troubleshooting
- g. Chapter 7. Corrective Maintenance
- h. Chapter 8. Repair Parts List
- i. Appendix A. List of Current Publications
- j. Appendix B. Related Technical Information and Procedures (exclusive of administrative procedures).

Chapter 1. General Information and Safety Precautions

5-2. CHAPTER 1. GENERAL INFORMATION AND SAFETY PRECAUTIONS

All safety precautions necessary for the protection of personnel and equipment shall be included or cross-referenced as the initial paragraph(s) ahead of introduction. Divide this chapter into two sections as follows:

- a. Section I. Introduction
- b. Section II. Equipment Description.

Provide an explanation of the purpose, scope, supersedure data, and applicability of the technical manual. Include, as well, the models, serial numbers, and configurations covered. State the interface relationship of the technical

5-3. SECTION I. INTRODUCTION

manual to other referenced publications. State the relationship of the equipment to referenced systems or other equipment. Include warranty/guarantee information, as applicable.

**5-4. SECTION II.
EQUIPMENT
DESCRIPTION**

Describe the intended use, capabilities, and limitations of the equipment. Keep text covering physical description or structural arrangements brief. Avoid unnecessary or repetitious details that are easily illustrated. Clearly show and identify the equipment and all of its units. If the technical manual covers more than one equipment configuration, provide a table defining the differences. The equipment description must include the following information:

**5-4.a. Equipment
Illustration**

- a. Equipment Illustration. Include an illustration representing all units comprising the equipment (see figure 5-1). Identify the following:

- (1) Major units of the equipment
- (2) Relative size of each unit
- (3) Basic interconnections between units
- (4) Relationship of units with other equipment.

5-4.b. Reference Data

- b. Reference Data. Include the following data in tabular form:

- (1) Descriptive (nameplate data). State the equipment manufacturer, type, model, and Marine Corps identification number, as applicable.
- (2) Functional. State such characteristics as power requirements, horsepower, pressure, capacity, modes of operation, power output, frequency, pulse, sensitivity, selectivity, and applicable tolerances.

- (3) Capabilities and Limitations. State such information as pounds of thrust, miles per hour, turning radius, minimum and maximum ranges, degrees of coverage, resolution and accuracy, as applicable.
- (4) Rated Outputs. State such information as wattages, voltages, horsepower and gallons per minute, as applicable.
- (5) Environmental. State such characteristics as ambient temperatures, heat dissipation per unit, and humidity limits.

c. Equipment, Accessories, and Documents Supplied.

Provide a tabular listing of the equipment, its units, and accessories (special tools, test equipment, miscellaneous parts, and Government furnished items) which form a part of or are supplied with the equipment. Set up the table as follows:

**5-4.c. Equipment,
Accessories,
and Documents
Supplied**

- (1) Column 1, Quantity. State the quantity of each unit and accessories supplied with the equipment.
- (2) Column 2, Item Name or Nomenclature. State the official name or nomenclature (name and designation) of each component, unit or accessory.
- (3) Column 3, Marine Corps Identification Number. State this number for each equipment unit or accessory, as available.
- (4) Column 4, Overall Dimensions. State the crated (if available) and uncrated height, width, and depth in inches (or inches and centimeters) of each unit or accessory.
- (5) Column 5, Weight and Volume. State the crated (if available) and uncrated weight and

volume in cubic feet of each unit and accessory.

**5-5. RELATED
ITEMS NOT
SUPPLIED**

Describe equipment, accessories, and related publications not furnished with the basic equipment that the manual covers, but which have an important relationship to it. Provide enough detail to establish their physical and functional relationship to the basic equipment.

**5-6. CHAPTER 2.
INSTALLATION**

Chapter 2. Installation

In this chapter, provide the information necessary for proper equipment installation. The illustrations are the principal means of conveying information. Text is supportive to the illustrations. This chapter covers the following topics:

- a. Site selection
- b. Reference publications
- c. Tools and material required
- d. Unpacking and repacking
- e. Foundation preparation
- f. Input requirements
- g. Installation procedures
- h. Installation checkout.

5-7. SITE SELECTION

Reference the appropriate installation drawings if they contain all necessary site information. Provide any additional information needed to supplement the drawings. This information may consist of technical factors possibly affecting equipment performance such as:

- a. Availability of power required
- b. Suitability of site for future expansion
- c. Clean line of site transmission patch

- d. Instructions for plotting terrain profiles
- e. Accessibility to the site
- f. Any other terrain or site factors.

Reference any general publications required to complete installation, if that information is more than two pages in length, or as directed by procuring agency.

**5-8. REFERENCE
PUBLICATIONS**

Include information supplemental to the summary list of installation material. If no supplemental text information is required, reference the installation drawings by figure number.

**5-9. TOOLS AND
MATERIAL
REQUIRED**

Include information supplemental to the installation drawings regarding unpacking and repacking. Provide step-by-step procedures to prevent damage to the equipment or injury to personnel. Include supporting illustrations to clarify procedures. When packing for reshipment is required, include step-by-step procedures and illustrations. When packing is simply the reverse of unpacking, this fact only need be stated. Provide any special environmental conditions required for storage. Include instructions for items in the following categories:

**5-10. UNPACKING AND
REPACKING**

- a. Depreservation procedures required at the time of installation
- b. Represervation packaging required prior to repacking for storage or shipment
- c. Intricate mounting, blocking, or bracing
- d. Special cushion inserts
- e. Repairable items
- f. Sensitive or fragile components
- g. Items held in special cradles
- h. Items furnished in reusable containers
- i. Special environmental conditions required for storage

- j. Special handling procedures required
- k. Container storage or disposition instructions, as applicable.

**5-11. PREPARATION
OF FOUNDATIONS**

Include information supplemental to the installation drawings. If all foundation preparation information is contained on the installation drawings, reference the drawings by figure number.

**5-12. INPUT
REQUIREMENTS**

Summarize input data contained on the installation drawings. State the parameters with tolerances for each of the inputs listed. Examples of inputs are as follows:

- a. Power
- b. Ventilation
- c. Dry air (waveguide pressure)
- d. Gyro information
- e. Fluid cooling
- f. Steam
- g. Freon.

**5-13. INSTALLATION
PROCEDURES**

Include the following types of supplemental information in the text, if not provided on the installation drawings:

- a. Instructions required to assemble units.
- b. Instructions required to mount units. Include bolting and bracing diagrams and data on shock mounts.
- c. Instructions for making electrical, plumbing, transmission line, and all other interface connections (external) to the equipment.
- d. Instructions for interconnecting units comprising the equipment.
- e. Servicing procedures, such as initial lubrication.
- f. Instructions for bonding and grounding.

Provide step-by-step procedures to demonstrate that the equipment operates correctly and within tolerances. Use a three-phase approach to structure the explanation:

a. Phase 1. Installation, Inspection and Pre-Energizing Procedures. Provide inspection procedures, in the form of checklists, to ensure that:

- (1) All units of the equipment and required auxiliary equipment have been installed. Check to see that their location and orientation is proper, and that all cables, antennas, waveguides, transmission lines, dehydrators, coolant lines, piping, etc., have been installed in accordance with plans and specifications. Be sure that continuity exists in all interconnections.
- (2) The required test equipment is available, operating satisfactorily, and has been calibrated.
- (3) All rotating devices are free from obstruction.
- (4) There is access to the equipment for maintenance.
- (5) It is safe to turn on the equipment.

b. Phase 2. Initial Turn-On and Preliminary Tests. Include procedures for energizing the equipment for the first time. Applicable portions of Operation Instructions may be referenced. Include step-by-step procedures for testing the equipment electrical supply circuits including distribution panels, switches, breakers, relief valves, and interlocks. Include procedures for testing piping,

**5-14. INSTALLATION
CHECKOUT**

**5-14.a. Phase 1.
Installation,
Inspection and
Pre-Energizing
Procedures**

**5-14.b. Phase 2. Initial
Turn-On and
Preliminary Tests**

electrical cables, wire rope, and stays. Also give procedures for proper installation of transmission lines and waveguides, hangar spacing, torquing of connectors, pressure testing, flow rates, standing wave ratio, attenuation checks, etc.

**5-14.c. Phase 3.
Installation
Verification
Tests**

- c. Phase 3. Installation Verification Tests. Include complete instructions for testing the equipment in all modes of operation. Procedures must cover the checking of gauges, meters, alarms, and other sensing devices for proper operation and calibration. These tests must verify that all inputs are in tolerance. Where applicable, include voltage standing wave ratio (VSWR) and insertion loss tests to verify the proper installation of antenna-to-equipment waveguide runs. Include transducer impedance and source level checks to verify proper installation of transducers, domes, and cables. Include preliminary set-up data in each procedure. When a required alignment must be accomplished before performing a test, include or reference it in the procedure. Present test procedures in a logical order as follows:

- (1) Energize the equipment.
- (2) Test the first units (normally power supplies) which must be operating properly. When test results are within the required tolerance, reference the next logical test. Also reference the corrective maintenance or troubleshooting data to be used if test results are not within tolerance.

Chapter 3. Functional Description**5-15. CHAPTER 3.
FUNCTIONAL
DESCRIPTION**

In this chapter, use the building block technique to explain how the equipment operates. Support the explanation with simplified schematic diagrams placed on the same page, if possible.

- a. Building Block Technique. Use the building block technique outlined below to describe equipment operation. Simplify any technical language in the description:

**5-15.a. Building Block
Technique**

- (1) Describe major equipment subassemblies. Illustrate description as shown in figure 5-2.
- (2) Describe the interaction of major equipment subassemblies. Illustrate description as shown in figure 5-3.
- (3) Describe, in detail, mechanical and electrical functioning. Illustrate description as shown in figure 5-4.
- (4) Describe how the equipment works. Illustrate description as shown in figure 5-5.

- b. Schematic Diagrams. Provide simplified schematic diagrams to illustrate the above information. Arrange these diagrams functionally to show circuit operation. Use graphic symbols to show electrical connections and the functions of a specific circuit arrangement. Applicable schematic diagrams are explained below:

**5-15.b. Schematic
Diagrams**

- (1) Integrated Circuits and Micro-Miniature Capsules. Include input and output connections, logic diagrams, and waveforms,

as applicable, for circuits within different types of nonrepairable integrated circuits and micro-miniature capsules. Manufacturer's data sheet information may be included if it meets technical content, format, and legibility requirements. (See figure 5-6.)

(2) **Simplified Piping Diagrams.** Show component interconnections, such as piping, tubing, or hose, and sequential flow in the system. Clearly identify pumps, heat exchangers, valves, gauges, etc. (See figure 5-7.)

(3) **Mechanical Schematic Diagrams.** Include the operational sequence and arrangement of the mechanical device including electrical control circuits. (See figure 5-8.) Show nomenclature, symbols, part identification numbers, and necessary descriptive data, as required. Show gears, shafts, clutches, levers, mechanically-driven switches, motors, synchros, etc., in functional arrangement. State gear ratios, number of teeth, direction of rotations, etc. Diagram symbols must conform to MIL-STD-17-1 and MIL-STD-17-2.

**5-15.c. Digital
Equipment
Explanation**

c. **Digital Equipment Explanation.** Note that the functional and hardware makeup of digital equipment requires a different presentation method and different descriptive requirements. For digital equipment, describe the functional relationship of the logic sections, units, and assemblies comprising the equipment. Include the following information:

(1) **Signal Characteristics.** Provide an introduction to and description of the signal characteristics. Include the following:

- (a) Signal levels or bi-stable states that the equipment uses, i.e., true (1) and false (0), and their relative voltage levels.
 - (b) Interpretation of the word-code bit structure, i.e., address, instruction, or data bit codes.
 - (c) Signals, identified by their operational accomplishment.
- (2) Functional Block Diagram. Provide an overall functional block diagram with descriptions. Prepare diagram as follows: (See figure 5-9.)
- (a) For multifunction equipment, whether single or multiunit, represent each major function as a block. Show the functional generation of outputs.
 - (b) Connect the blocks by lines and arrowheads showing the direction of the flow.
 - (c) Identify each block by the functional name only.
 - (d) Identify each equipment input and output by title. Include waveforms as applicable.
 - (e) Identify modes of operation by title or symbols, as applicable.
 - (f) Show ancillary equipment by blocks when the ancillary equipment is associated with major functions. Identify ancillary blocks by nomenclature and label as "(Ancillary)."
- (3) Logic Principles. Include logic principles beginning with an introduction to the basic digital logic symbology used in the manual.

Describe each logic function and support the description with Boolean equations, simplified logic diagrams, and timing diagrams.

(4) **Functional Description.** Explain power distribution, power supplies, and regulators, as follows:

- (a) Briefly describe conventional electronic circuits found in applicable United States of America Standards Institute (USASI) publications (see paragraph 1-4-c). Support the description with reference to the maintenance schematic diagrams in Chapter 5.
- (b) Describe, in detail, circuits not covered in applicable USASI publications. Support the description with simplified schematic diagrams in Chapter 5.
- (c) Describe alternating current (ac) and direct current (dc) power distribution in detail. Support the description with reference to the power distribution diagrams in Chapter 5.
- (d) Describe mechanical devices, cooling systems, etc. Support the description with reference to mechanical schematic diagrams and digital equipment diagrams identified in Chapter 5.

Chapter 4. Operation**5-16. CHAPTER 4.
OPERATION**

Include all the procedures necessary to enable operating personnel to use the equipment properly and to understand the operation. Provide enough detail to allow operators, not trained on the equipment, to operate it independently and safely without explanation. Chapter 4 contains four sections as follows:

- a. Section I. Introduction
- b. Section II. Controls and Indicators
- c. Section III. Operating Procedures
- d. Section IV. Operation of Equipment Used In Conjunction with Major Item.

Describe the operator's relationship to the equipment. Identify those units having controls and indicators that the operator must use for performance of duties. Support the introduction with illustrations and tables that identify and locate all operator controls and indicators. Explain the intended function and application of the equipment so that the operator will know exactly what they should expect to accomplish with the equipment. The following sections identify in detail what the operation instructions entail.

A description of all operator controls, indicators, protective devices and jacks shall include the following:

**5-17. SECTION I.
INTRODUCTION****5-18. SECTION II.
CONTROLS AND
INDICATORS**

- a. Names of panel designations as marked on the equipment.
- b. Positions and operating functions for each control, and the normal operating condition of each indicator in each of the operating functions.
- c. Detailed illustrations to support the text. (See figure 5-10.)
- d. Operator's Controls and Indicators table (see figure 5-11) that references illustration in which figure appears, item, and function.
- e. When operation requires more than one person, indicate the designated position and function of each. Specify the relationship between controls and indicators, and position and function, for each operator.

**5-19. SECTION III.
OPERATING
PROCEDURES**

Provide the following information on operating procedures:

**5-19.a. Operator
Turn-On**

- a. Operator Turn-On. Include all steps necessary to bring equipment from OFF through STANDBY condition to full operation.

**5-19.b. Modes of
Operation**

- b. Modes of Operation. State procedures for each mode of operation, e.g., manual, automatic, local, remote, etc. Describe the use and relative advantage of each mode of operation.

- | | |
|---|---|
| c. <u>Operation Under Interfering Conditions.</u> Describe equipment anti-jamming and interference reduction features. Describe advantages of each feature and operating procedures to be followed in all possible situations. Include supporting illustrations (e.g., indicator displays, waveforms, etc.) that provide typical observations of jamming and interference for evaluation by the operator. | 5-19.c. Operation Under Interfering Conditions |
| d. <u>Operator Turn-Off.</u> Include all steps necessary to bring equipment from full operation through STANDBY to OFF condition. | 5-19.d. Operator Turn-Off |
| e. <u>Emergency Operation.</u> Cover operation of equipment during emergency conditions. (e.g., control failure, air failure, lube oil failure). Include emergency operation instructions. Provide a warning or caution to return the equipment to proper operation when the emergency is over. | 5-19.e. Emergency Operation |
| f. <u>Emergency Turn-Off.</u> Explain how to turn equipment off during an emergency (e.g., fire, water, smoke, hazard to personnel, loss of coolant, normal power, etc.). | 5-19.f. Emergency Turn-Off |
| g. <u>Method of Presentation.</u> Operating procedures shall be presented in tabular form and shall be in concise, simply-worded, step-by-step procedures and shall include the following:

(1) A short explanation of the operation to be performed.

(2) Initial safety requirements (actions, inspections, and reference to emergency turn-off procedures). | 5-19.g. Method of Presentation |

- (3) Connection of any accessory equipment not permanently connected.
- (4) Instructions for obtaining or confirming the presence of all critical inputs such as power, coolant, air, signal, air conditioning, etc.
- (5) Procedures for setting controls and making adjustments which must be accomplished by the operator prior to equipment turn-on.
- (6) Procedures for determining operational readiness and the acceptable indicators such as meters, lamps, gages, cathode ray tubes, and recorder readouts.
- (7) Milestones in the operational status of the equipment shall be identified and included by brief statements such as "the generator is now in STANDBY."
- (8) Visual or aural observations which occur as a result of an operator action, such as boom lowering, sweep rotation, blower motor running, etc.
- (9) Procedures that can be hazardous to personnel or equipment shall be emphasized by WARNINGS or CAUTIONS placed immediately prior to the specific step involving the possible hazard. "Notes" shall not be used.
- (10) Illustrative material supporting the procedures shall identify and locate all operating controls and indicating devices as well as normal in-use positions or indications.

(11) Operator's checks and adjustments in proper sequence.

(12) Operator's maintenance actions and schedules.

This section contains detailed descriptions and instructions on the operation of auxiliary equipment. It is needed only when pertinent items are not covered by other available technical publications listed in paragraph 1-4. Cover equipment such as cold starting aids, heaters, fire extinguishers, hoists, winches, and engine heaters supplied for use with the basic item, unless waived by the procuring agency. If the auxiliary equipment has a separate manual, reference that manual and list it in the appendix or publications listing, as applicable.

Chapter 5. Scheduled Maintenance

This chapter contains maintenance procedures and performance tests to be done on a scheduled or condition monitoring basis. Divide Chapter 5 into four sections, as follows:

- a. Section I. Introduction
- b. Section II. Tools and Equipment
- c. Section III. Organizational and Intermediate Level Maintenance
- d. Section IV. Care and Preparation for Storage/Shipment.

Explain the purpose, scope, and arrangement of the maintenance procedures. Write as a CAUTION any procedural steps required on a scheduled basis to prevent equipment damage.

5-20. SECTION IV. OPERATION OF EQUIPMENT USED IN CONJUNCTION WITH MAJOR ITEM

5-21. CHAPTER 5. SCHEDULED MAINTENANCE

5-22. SECTION I. INTRODUCTION

**5-23. SECTION II.
TOOLS AND
EQUIPMENT**

In this section, specify the tools, equipment, and repair parts which must be issued to the operator. Briefly locate and describe storage boxes and compartments, brackets, ammunition, racks, and the like. List electronic test equipment by Joint Army-Navy (JAN) nomenclature. List other items by the proper Cataloging Handbook nomenclature. Provide illustrations showing the use of any special tools or equipment for adjustment or calibration. Place these at the point where the instruction is given.

**5-24. SECTION III.
ORGANIZATIONAL
AND INTERMEDIATE
LEVEL MAINTENANCE**

This section contains both organizational and intermediate level maintenance. Include the following information in this section:

**5-24.a. Organizational
Maintenance**

- a. Organizational Maintenance. Organizational maintenance is the responsibility of a using organization. Its phases normally consist of inspecting, servicing, lubricating, and adjusting parts. Organizational maintenance also involves replacement of parts, minor assemblies, and subassemblies not requiring highly technical skills. There are two maintenance echelons within organizational maintenance--first and second echelons. First echelon refers to the maintenance that the user or operator performs. Second echelon maintenance is performed by specially trained personnel provided for that purpose in the using organization. Organizational maintenance information consists of the Introduction, the Scheduled Maintenance Action Index, Preventive Maintenance Procedures, and Scheduled Performance Tests. Each is explained below.

- b. Introduction. Explain the purpose, scope, and arrangement of the maintenance data. When a maintenance procedure is critical to the operation of the equipment, and the schedule for servicing is absolute (not just recommended), write this information conspicuously as a caution.
- c. Scheduled Maintenance Action Index. This index is used to specify scheduled performance tests and scheduled maintenance procedures. (See figure 5-12 for a sample of a scheduled maintenance action index.) Tabulate the index as follows:

5-24.b. Introduction**5-24.c. Scheduled
Maintenance
Action Index**

- (1) Column 1, Interval. Provide an alphanumeric list of all maintenance actions contained in the chapter. Use the following interval symbols, as appropriate, in the order of increasing interval, as listed below:

<u>Interval</u>	<u>Symbols</u>
Hourly	H
Daily	D
Weekly	W
Monthly	M
Quarterly (3 months)	Q
Semiannually (6 months)	S
Annually (12 months)	A
Overhaul cycle	C
As specified (explain circumstances)	R ¹

¹Precede an R interval by a recommended calendar interval, e.g., daily as specified (DR), weekly as specified (WR), etc.

- (2) Column 2, Maintenance Action. List the maintenance action which corresponds to the interval number in column 1.

- (3) Column 3, Reference. State the paragraph or table number of the maintenance procedure that corresponds to the maintenance action in column 2.

**5-24.d. Preventive
Maintenance
Procedures**

- d. Preventive Maintenance Procedures. Include information required to inspect, clean, and lubricate the equipment. State the following, as applicable:

- (1) Safety precautions.
- (2) Tools, parts, materials, and test equipment required.
- (3) Cleaning solvents. Use government specification numbers and federal stock numbers to identify.
- (4) Instructions for properly maintaining all safety devices and interlocks, with warnings and cautions.
- (5) Instructions for lubrication at operating temperatures, and types and quantities of lubricants to be applied. Use government specification numbers and federal stock numbers to identify lubricants. Include specific lubricants for arctic or tropic environments. When a proprietary lubricant is approved, list a government specification lubricant as an emergency substitute.
- (6) Procedures for obtaining access to subassemblies or subcomponents.
- (7) Instructions for in-place balancing and noise reduction.
- (8) Inspection procedures for parts which deteriorate due to cycles of use, age, or climatic conditions.

- (9) Illustrations to identify lubrication points and other pertinent data.
- (10) Other information pertinent to these procedures.

e. Scheduled Performance Tests. Provide step-by-step procedures necessary to verify that the equipment is operating within standards in all modes of operation. Include the following:

- (1) Safety precautions.
- (2) List of tools and test equipment identified by type, manufacturer, and model number.
- (3) Title of the test to be performed.
- (4) Preliminary set-up data required to perform the test.
- (5) Detailed procedures for accomplishing the test. Procedures requiring lengthy and identical set-up data may be presented in detail in one procedure and referenced in succeeding procedures.
- (6) Values or conditions, with tolerances, indicative of normal operation.

f. Intermediate Maintenance. Intermediate maintenance is performed by a designated maintenance activity to support the user of a piece of equipment in the field. That maintenance activity may also be supported by a higher echelon of maintenance. Intermediate maintenance is normally limited to replacement of parts, subassemblies, and assemblies. When intermediate maintenance units support lower echelons, they provide technical assistance and mobile repair

**5-24.e. Scheduled
Performance
Tests**

**5-24.f Intermediate
Maintenance**

parts. Provide the following information on intermediate maintenance inspections and schedules as indicated below:

**5-24.g. Maintenance
Inspections**

- g. Maintenance Inspections. Establish go/no-go acceptance-rejection criteria for wear, dimensions, clearances, surface finishes, and electrical resistances. Also establish go/no-go acceptance-rejection criteria (or another appropriate acceptance standard) for alignments, backlash, play, leakage, vibrations, noise, aging, corrosion, and erosion of each applicable part. Base criteria on the need for satisfactory performance with no more than routine maintenance until the next similar inspection. Include calibration requirements for special tools and instruments. Provide a list of items for replacement if inspection so indicates. (Also provide guidance on suitability of worn-in parts versus new parts, wherever appropriate.) Include detailed disassembly procedures. List procedures for reconditioning reusable parts and subassemblies before reassembly. Provide critical inspection and review procedures for new parts. Include comparisons with parts being replaced to establish equivalence before installation. State critical operations and checks to be performed during reassembly.

5-24.h. Schedule

- h. Schedule. Establish a time schedule for all maintenance actions such as inspections, tests, adjustments, and reconditioning. Include a schedule for parts replacement. Indicate all other parts which should be available to allow replacement if inspection so indicates over the

life cycle of the equipment. Provide detailed maintenance and overhaul procedures at intermediate maintenance levels for reconditioning or replacement of each part, subject to continuing degradation, before degradation results in major failure. Specify in detail inspection measurements, tolerances, work, tests, and quality assurance operations required to provide satisfactory maintenance.

Include this section in all manuals covering intermediate maintenance or higher. Provide necessary instructions for preparing the equipment for storage so that it will be adequately protected under prevailing climatic conditions. Include specially required technical inspection, cleaning, preservation, lubrication, weather-proofing, and any other special services necessary to prepare the equipment for storage. Address requirements for storage periods of up to three months as well as long-term storage requirements. In the latter, processing, packaging, and packing requirements will be more extensive. See paragraph 5-10 for information on preparation for shipment.

Chapter 6. Troubleshooting

This chapter contains all instructions and information necessary to locate equipment malfunctions and to conduct tests on each component, assembly, or subassembly of the equipment.

Provide a troubleshooting table (see figure 5-13) for logical isolation of faults. List step-by-step procedures for troubleshooting. Direct the technician to observe meters, fuses, circuit breakers, valves, and other

5-25. SECTION IV. CARE AND PREPARATION FOR STORAGE/ SHIPMENT

5-26. CHAPTER 6. TROUBLESHOOTING

5-27. TROUBLE- SHOOTING TABLE

available indicators that would show the presence of trouble. Provide complete instructions on signal tracing for electric circuits including the use of special test instruments and unusual servicing techniques.

**5-28. TROUBLESHOOTING
DEPENDENCY
DIAGRAMS/CHARTS**

Provide one of the following types of troubleshooting diagrams or charts to augment the troubleshooting procedures:

**5-28.a. Fault Logic
Diagrams**

- a. Fault Logic Diagrams. Fault logic diagrams are based on a fault indication that may be observed during troubleshooting (see figure 5-14). These diagrams comprise a branching series of questions on fault isolation. Each question pertains to a further observation or measurement, and results in a "yes" or "no" answer. (Present tolerance values in those instances where a definitive "yes" or "no" cannot be obtained.) The series of questions progressively narrows the possible functional area of the equipment containing the fault. The user is then referred to that portion of the manual containing information needed to complete fault isolation and repair. In each diagram include or reference the information necessary to establish test or operating conditions required for starting the fault isolation procedure. Use only three types of blocks as described below:

- (1) **Shaded Blocks**. The right and bottom border lines of these blocks are weighted. In shaded blocks, place questions that may be answered from observation, without changing test setup and without special equipment.

- (2) **Single-Line Blocks.** In these blocks, place questions requiring measurement with specially set-up external test equipment.
 - (3) **Double-Line Blocks.** These blocks are conclusion boxes. In them list the functional area within the equipment that is the probable source of malfunction. Reference a procedure or another diagram for further isolation or correction of a fault.
- b. Troubleshooting - Maintenance Dependency - Matrix Chart. Matrix charts show the functional dependency of output signals or indications upon circuit elements, circuits, modules, etc. (See figure 5-15). Present this chart in the form of a grid as follows:
- (1) Annotate each vertical column to represent a circuit element, circuit, module, etc.
 - (2) Annotate the horizontal rows to represent a procedural step that results in an observable output or indication.
 - (3) Use symbols in the body of the grid to show the relationship between circuit elements, circuits, etc., and observable output or indication.
 - (4) Exercise all circuits, modules, etc., in a manner to permit logical diagnosis.
 - (5) Clearly define all outputs and give performance specifications.
 - (6) Define all symbols.
 - (7) Fully explain use of the chart.
- c. Printed Wiring Assembly Illustrations. Printed wiring assemblies are assemblies in which conductive, semi-dielectric or magnetic patterns are

**5-28.b. Troubleshooting-
Maintenance
Dependency -
Matrix Chart**

**5-28.c. Printed
Wiring Assembly
Illustrations**

formed by photo etching, silk screening, stamping, vapor deposit, or similar processes. (This chapter does not cover printed wiring boards used within microelectronic assemblies, multilayer printed wiring assemblies, and flexible wiring.) Present the information according to the following (see figure 5-16):

- (1) **Illustrations Required.** In technical publications covering intermediate and depot maintenance, include a schematic diagram and a master assembly drawing for each type of printed wiring assembly drawing used in an equipment or system. Only one schematic and one master assembly drawing is required when two or more identical, printed wiring assemblies are used in the same equipment or system.
- (2) **Location and Page Size of Illustrations.** Prepare each printed wiring assembly, schematic diagram, and master assembly drawing for inclusion as a foldout in the finished technical publication. Place illustrations only on the facing pages of foldout sheets. Do not exceed the foldout image area size permitted by the specification(s) governing the preparation of illustrations for use in the particular publication in which they appear. Unless specifically prohibited by the specification(s), place printed wiring assembly schematic (foldout) diagrams and master assembly (foldout) drawings at the end of the appropriate section, chapter or volume, depending upon the specific type of publication.

- (3) Arrangement, Titling, and Numbering of Illustrations. Place each master assembly (foldout) drawing on the facing page of the foldout sheet immediately behind that on which the schematic (foldout) diagram appears for that particular assembly. A schematic diagram and associated master assembly drawing may be included on the facing page of the same foldout sheet when size permits. When this is done, place the master assembly drawing to the right of the schematic diagram. Prepare page numbers, figure numbers, and figure titles for printed wiring assembly illustrations in accordance with the specification (s) governing the preparation of the technical publication in which they appear.
- (4) Master Assembly Drawing Illustrations. Prepare master assembly drawings, appearing as illustrations in technical publications, in a format similar to that shown in figure 5-17. Comply with the requirements stated below:
 - (a) Component Side Conductor Pattern. The printed wiring conductor pattern (and printed components if any) on the component side of a printed wiring assembly board must be printed in black. The pattern must be a true copy of that prepared for and used in the printed wiring assembly fabrication process. The view must be that seen from the component side of the assembly. Those portions of the conductor pattern, which are partially obscured by separable

components (capacitors, resistors, etc.) attached to the board must appear as dashed line segments.

(b) Component Side Separable Components.

Outline the physical configurations of separable components, attached to the component side, by means of light weight black lines. The line weights must conform to (c) below. The outlines must appear at the approximate physical locations of the respective separable components relative to segments of the conductor pattern. Show separable component (flexible wire) leads as lightweight lines extending from each of the respective components to those points on the conductor pattern at which the actual physical connections are made. Present separable component schematic diagram designations in black, within or adjacent to, the associated separable component outlines.

(c) Relative Line Weights. The width of lines used to illustrate separable component outlines and separable component (flexible wire) leads must not exceed one fourth of that used to depict the printed wiring conductor pattern.

(d) Conductor Side Printed Wiring Pattern and Components. When a conductor pattern is also imprinted on the side of a printed wiring assembly board opposite that on which separable components are attached (defined as the conductor side), this pattern must appear in a 50 ± 5 percent gray in the master assembly drawing. The

conductor pattern must appear as seen through the printed wiring assembly board from the component side and must be properly aligned with respect to that on the component side. Outline separable components attached on the conductor side in lightweight gray lines. Include separable component schematic designations in accordance with (e) below.

- (e) Conductor Side Illustration Options. The following are illustration options which may be cited in the contract or by the procuring officer. If not specified by either, the selection of these options is at the discretion of the contractor or preparing agency:

- 1 To emphasize separable components on the conductor side, dashed, lightweight, gray diagonal lines may be included within the component outlines.
- 2 Schematic designations for components located on the conductor side of an assembly must be included. These designations, such as R4, R28, etc., may be printed in black or gray, or in gray and reverse.

- (5) Printed Wiring Assembly Maintenance Data. Supply maintenance data for each type of printed wiring assembly used in an equipment or system.

5-28.d. Piping Diagrams

5-28.e. Control Diagrams

- d. Piping Diagrams. See paragraph 5-15.b(2).
- e. Control Diagrams. Include control diagrams (see figure 5-18) for all control circuits. Group circuits according to energizing voltage, control function, mode of operation, or physical limits of cabinet or assembly, as applicable. Provide supporting information required to clarify the use of the diagram in the general notes. Include the functional name and reference designation for each relay, switch, lamp, etc., illustrated. Show all relay energizing circuits with all tie points and terminals, and with switches and relay contacts, in their operating positions. Show all terminal connections, switches, interlocks, contacts or other relays in a series with the energizing path, plus lamps or indicators (electrically connected in the energizing or indicating status of contact closures). Place the following note on all control diagrams: "All switches and relay circuits are shown in operating positions."

**5-28.f. Power
Distribution
Diagrams**

- f. Power Distribution Diagrams. Power distribution diagrams (see figure 5-19) depict the distribution of primary ac power, secondary ac power, and dc power from the terminal board, breaker, or fuse box to the various subassemblies or modules of the equipment. Normally, a separate diagram must be prepared for each voltage level used within the equipment. The following rules apply in the preparation of power distribution diagrams:
 - (1) Show and identify motors, transformers, regulators, power supplies, assemblies, subassemblies and modules.
 - (2) Show and identify all power line devices such as fuses, circuit breakers, switches, and relay contacts.

- (3) Show and identify all connections including plugs, jacks, and terminal boards in the distribution path.
- (4) Use dot and dash lines to set off hardware boundaries such as units, assemblies, and subassemblies. Identify each unit, assembly, and subassembly by reference designation. Reference the schematic diagram covering the unit, assembly, and subassembly.
- (5) Reference all relay contacts to the appropriate control diagrams. All relay contacts must be shown in the operating position.
- (6) Include voltages and tolerances, as required.
- (7) Show and identify all metering circuits and indicators.
- (8) Show all grounds, commons, neutrals, and return lines.
- (9) Whenever practicable, display the power path from left to right and from top to bottom.
- (10) The functional names of all "main line" switches and circuit breakers must be conspicuously marked on the diagram. In addition, set off any power control markings engraved or stencilled on the equipment in a rectangular box, for example, "MAIN POWER."
- (11) Show all relay coils in series with the main power distribution path. Relay control circuits shown on control diagrams need not be repeated on distribution diagrams.
- (12) Place the following note on all control diagrams: "All switches and relay circuits are shown in operating positions."

**5-28.g. Mechanical
Schematic
Diagrams**

- g. Mechanical Schematic Diagrams. See paragraph 5-15.b(3).

**5-28.h. Maintenance
Schematic
Diagrams**

- h. Maintenance Schematic Diagrams. Maintenance schematic diagrams (see figure 5-20) include unit-to-unit interconnection diagrams, intra-unit interconnection diagrams, and unit, assembly, and sub-assembly schematic diagrams. These diagrams must provide complete coverage of the equipment. Prepare maintenance schematic diagrams in accordance with MIL-M-38784 and the following:

- (1) Draw the schematic diagram for each unit so that, together with the interconnecting diagrams, all circuit elements are included and all circuits can be traced from unit to unit.
- (2) Zone schematic diagrams by alpha-numeric coordinates. Include location of all circuit elements by zones in a table located on the apron. When a part such as a relay or a twin tube is drawn in sections at different locations, list as many coordinates as necessary to locate all sections.
- (3) Represent major and minor signal paths by different line weights. Use the heavier line weight to show the major signal path. Make signal flow from left to right and from top to bottom whenever possible. Place arrowheads denoting the direction of signal flow on the signal flow lines.
- (4) The use of ground and voltage busses is discouraged except in the power supply. However, voltage bus connections can be

shown by broken lines directly beneath the connection. As a substitute for ground busses, use individual grounds and include appropriate notes to indicate sources.

- (5) Show all significant voltages at busses, tube pins, and transistor elements except when this data can be presented best in a voltage chart. Indicate whether the voltage is ac (alternating current) or rf (radio frequency). Show dc (direct current) voltages by polarity.
- (6) Mark the functional names of all operating controls and adjustments conspicuously on the schematic, for example, "VERT CENT, BIAS ADJ." In addition, set off any operating front panel markings on the equipment in a rectangular box, for example, "RF GAIN, AGC ADJ." Include the functional name of all stages (tubes, transistors, etc.).
- (7) Identify and indicate the function, source, and destination of all input and output circuits by figure number.
- (8) Designate power and signal frequencies in Hertz (Hz). Note resistance values, if more than one ohm, for all wire-wound devices such as motors, relay coils, and transformers. Give tolerances for all values (\pm tolerances).
- (9) Indicate rated current and voltage values of primary and secondary windings of power transformers.
- (10) Provide a resistance and voltage chart for a schematic diagram on the page apron. This chart must give the normal resistance and voltage to ground (or other points of significance) for each tube socket pin with acceptable tolerances. In addition, list all

conditions which affect the resistance or voltage values given, such as control settings, equipment connections, tubes removed from sockets, etc. If semiconductors (transistors, diodes, etc.) are employed in circuits, adequate caution notices must be included to prevent damage to these devices when making resistance measurements in the circuit. No intra-element resistance measurements (i.e., between emitter, base, and collector) are required to be made on transistors themselves. Also, indicate resistance of power supply busses and other points of significance.

- (11) Identify each schematic diagram by the reference designation number, located in the lower right-hand corner of the image area.
- (12) Present schematic diagrams in alpha-numeric order corresponding to the reference designation of units, assemblies, subassemblies, etc. When two or more identical assemblies or modules are used, redundant schematic diagrams need not be repeated. However, a table that cross-references the reference designation to the figure number of the common schematic diagram must be provided immediately preceding the schematic diagram. For identification purposes, schematic diagrams covering more than one unit, assembly, or module must include, in the lower right-hand corner of the illustration, all the reference designations of the unit, assemblies, and modules to which they refer, e.g., 1, 1A1, 2A7, 3A19.

-
- (13) Group circuit elements functionally and arrange them to make signal flow obvious from left to right and top to bottom. Do not arrange circuit elements to fill up white space or to maintain tube or transistor alignment. Arrange circuit elements in textbook form for the convenience of the user. Do not distort layout to achieve fit.
- i. Logic Diagrams. Provide logic diagrams (see figure 5-21) for digital devices and digital aspects of conventional equipment. Logic diagrams must conform to MIL-M-38784.
- j. Control Cycle Diagrams. Control cycle diagrams (see figure 5-22) of digital equipment must show the entire cycle on a single, signal flow logic diagram together with an appropriate note describing key operating features.
- k. Timing Circuit Diagrams. Provide timing circuit diagrams (see figure 5-23) for all significant timing relationships. These diagrams must show the exact timing relationships and the origins of all timing signals (conventional and digital).
- l. Single-Function Diagrams. Logic diagrams for non-programmable devices, which result in a unique output function, may be prepared to the requirements of signal flow diagrams.
- m. Module Logic Diagrams. Provide module logic diagrams for all modules.
- n. Flow Charts. Provide flow charts for digital devices to support the explanation of machine instructions and test programs. The flow charts must conform to USASI X3.5.
- 5-28.i. Logic Diagrams**
- 5-28.j. Control Cycle Diagrams**
- 5-28.k. Timing Circuit Diagrams**
- 5-28.l. Single-Function Diagrams**
- 5-28.m. Module Logic Diagrams**
- 5-28.n. Flow Charts**

**5-28.o. Coding
Instruction
Sheets**

- o. Coding Instruction Sheets. Provide coding instruction sheets (see figure 5-24) for all programs. The listing must contain all coding and address data as well as an adequate notes section to ensure understanding.

5-28.p. Test Programs

- p. Test Programs. Test programs with coding instruction sheets must be developed and included to support troubleshooting procedures.

**5-29. CHAPTER 7.
CORRECTIVE
MAINTENANCE**

Chapter 7. Corrective Maintenance

This chapter contains instructions required to adjust and align the equipment, and to remove, repair, reinstall, and align all repairable parts, modules, subassemblies, and assemblies. The instructions must identify the action to be accomplished; safety precautions to be observed; and tools, parts, materials, and test equipment required. They must also identify preliminary control settings, test equipment setup instructions, and step-by-step instructions, with supporting illustrations, to accomplish the maintenance task. Provide corrective maintenance instructions for all items designated repairable, irrespective of the maintenance concept, unless the information is included in another technical manual and can be referenced. Divide Chapter 7 into three sections as follows:

- a. Section I. Introduction
- b. Section II. Adjustments and Alignments
- c. Section III. Repair.

**5-30. SECTION I.
INTRODUCTION**

Explain the purpose, scope, and arrangement of the corrective maintenance data.

Provide all information and procedures required to perform all necessary adjustments and alignments as follows:

- a. Non-operator type adjustments
- b. Alignments requiring external jigs, test equipment, or bench setups
- c. Alignments that are accomplished after a repair or replacement of a part or module
- d. Test equipment setup and other illustrations necessary to support the procedures.

State all procedures required in the repair of assemblies and repairable parts. Repair procedures include but are not limited to the following:

- a. Removal, disassembly, and inspection
- b. Repair or replacement of piece parts
- c. Cleaning, reassembly, adjustment, installation, calibration, and checkout
- d. Exploded views, sectional views, wiring diagrams, and photographs necessary to support the procedures
- e. Do not include obvious repair actions such as soldering, use of multimeters, hand tools, etc., unless those actions involve hazards to personnel or equipment
- f. Arrange repair procedures in numeric-alpha unit designation order of the equipment.

Use clear, sharp illustrations to supplement description and maintenance coverage. Use exploded views for parts location illustration. As a minimum, include illustrations of the following, when applicable:

**5-31. SECTION II.
ADJUSTMENTS
AND
ALIGNMENTS**

**5-32. SECTION III.
REPAIR**

**5-33. SUPPORTING
ILLUSTRATIONS
AND DATA**

- a. Typical bearings for rotating or moving equipment
- b. Method of taking clearance measurements
- c. Typical mechanism for absorbing thrust
- d. Locking devices
- e. Typical seal assembly (pressure and/or vacuum seals or controlled leakage between rotor and casing)
- f. Typical assembly of blading to rotor, with lock devices
- g. Typical assembly of field poles, laminated core iron, electrical windings, commutator, slip rings, and brush rigging
- h. Equipment assembly with upper casing partially removed
- i. Series of illustrations showing illustration of supervisory instruments.

**5-34. CHAPTER 8.
REPAIR PARTS
LIST**

Chapter 8. Repair Parts List

The repair parts list (RPL) must conform to the requirements stated in this chapter (see figure 5-25). The RPL serves as a list of all parts required to maintain and support the equipment. The RPL furnishes complete data, including items used in conjunction with and furnished as part of, or with, the equipment, to enable the user to perform required maintenance and supply support of the described equipment. Divide Chapter 8 into five sections, when applicable, as follows:

- a. Section I. Item Identification Listing
- b. Section II. Item Number Cross-Reference
- c. Section III. National Stock Number Cross-Reference
- d. Section IV. Part Number Cross-Reference
- e. Section V. Circuit Symbol Number to Item Number Cross-Reference.

This listing comprises the main part of the RPL. Arrange the columns to show stock numbers, item identification, replacement factors, and other data necessary to maintain the equipment in operative condition. Illustrations are placed either before, or close to, the component or assembly. Use the topdown breakdown sequence within the major combination. Identify all repair parts contained in the equipment and number in sequence by component. Repair parts need not be identical with parts of the original equipment, but as replacement parts they are considered suitable or preferred. Prepare RPL table as follows (see figure 5-26):

- a. Column 1, Item Number. Specify item numbers assigned in numerical sequence and in the order that each item appears in the RPL. The item numbers are provided for reference purposes. In emergencies, these item numbers may be used for RPL number and date on requisitions which combat units transmit by message.
- b. Column 2, Model. Indicate by an alphabetical code the specific application of repair parts, components, or assemblies when more than one model of an assembly, component, or equipment is contained in the RPL. The absence of the code indicates that only one version of the item (assembly, component, or equipment) is covered by the RPL.
- c. Column 3, Stock Number. Furnish National Stock Numbers (NSNs) assigned to those centrally managed items required for the support of the equipment. When assigned, NSNs will be used in all supply operations, from original purchase to final disposal of the item. Absence of an NSN

5-35. SECTION I. ITEM IDENTIFICATION LISTING

5-35.a. Item Number

5-35.b. Model

5-35.c. Stock Number

indicates the item is not normally stocked as a repair part, as indicated by the source code portion of the Source Maintenance Recoverability (SMR) code (see paragraph 5-35.i). If an item without an NSN is required, determine if the item can be obtained from assembly, manufacturer or salvage by referring to the source code. Items not stock numbered, that cannot be obtained from these sources, may be re-questioned using the manufacturer's code and part number referencing the RPL number, date of the RPL and the line item number which applies. See figure 5-27 as an example of Federal Supply Codes for Manufacturers.

5-35.d. Reference
Designator

- d. Column 4, Reference Designator. Include alphabetical and/or numerical designators for referencing an individual repair part to an illustration. The absence of a reference designator indicates there is no illustration for the part.

5-35.e. Indenture Code

- e. Column 5, Indenture Code. Specify the Indenture Code Letter which indicates the relationship of a line item to the end item or to the preceding component, assembly, or subassembly. Visual indentation of the line item is not shown; however, the Indenture Code Letter will enable the user of the RPL to interpret the relationship of the line item with its next higher assembly. See figure 5-28 for the relationship of Indenture Code letters.

5-35.f. Item Identification

- f. Column 6, Item Identification. Identify the item name and description of the repair part. When an item is duplicated in the major combination, the abbreviation (S/A) is inserted after the noun name to indicate "same as". S/A items refer to the line item number of the item's first appearance in the

major combination. When an item is fabricated from other items, the abbreviation FAB FR, followed by the item required for the fabrication, is inserted after the item identification. When an item is assembled from other items, the abbreviation ASSEM FR is used, followed by each item required for the assembly of the item. When the items comprise a kit or set, a complete list of the components will be given in alphabetical order immediately following the item, under the heading "Consist of ", abbreviated (C/O).

- g. Column 7, Unit of Measure. Indicate the measure of quantity specified in column 8 but do not use for requisitioning purposes. When requisitioning parts, the Unit of Issue, Stores Account Code, and Unit Price should be obtained from the "Federal Supply Catalog, Management Data List (C-ML-MC)."
- h. Column 8, Quantity. Divide this column into sub-columns (A) and (B) and indicate the following:

- (1) Sub-column (A) - the quantity of a maintenance or non-maintenance part used in a specific application within an end item.
- (2) Sub-column (B) - the consolidated quantity of a maintenance part used in an end item upon the item's first appearance in this list.

- i. Column 9, Source Maintenance Recoverability Code. Include a series of alphabetic letters which denote the uniform source, maintenance, and recoverability coding structure. This code is assigned to items subordinate to or associated with an end item, i.e., spares, repair parts, and support equipment. The uniform code format is composed of three parts

5-35.g. Unit of Measure

5-35.h. Quantity

5-35.i. Source Maintenance Recoverability Code

consisting of a two (2) position Source Code, a two (2) position Maintenance Code, and a one (1) position Recoverability Code. The code identifies: (1) the method of obtaining the item; for example, by requisition, fabrication, or salvage; (2) the lowest maintenance echelon authorized to remove, replace, and use the item and the lowest echelon capable to perform complete repair; and (3) disposition action on unserviceable items. See figures 5-29 and 5-30 for examples and definitions/application of SMR codes respectively.

**5-35.j. Special Stockage
Indicator Code**

- j. Column 10, Special Stockage Indicator Code. State the condition under which certain maintenance parts, (parts assigned NSN's and coded in the "P" series source code of the SMR code), are stocked. See figure 5-31 for explanation of the codes.

**5-35.k. Replacement
Factor**

- k. Column 11, Replacement Factor. Indicate the replacement factor assigned to each maintenance repair part with an NSN. This factor is assigned to the repair part on its first appearance in the publication. The replacement factor, expressed as a decimal, indicates the average rate at which the type of item so coded has been used by the Marine Corps field units or the rate at which design engineers anticipate the item will fail, wear out, or otherwise require replacement. Base all computations on a replacement period of one year. Therefore, a replacement factor of 0.08, applied to an item in the stocklist, indicates that eight out of every one hundred of such items used in the end item of equipment is predicted to need replacement in one year. Likewise, 0.004 reflects

that four out of every thousand in use are predicted to require replacement in one year, while 2.0 shows that every one in use is predicted to be replaced twice during each year.

- (1) Compute initial authorized stockage levels of consumable and salvageable items for an organization for predicted consumption based on the number of items employed and/or supported by an organization within the number of days for which stockage is authorized. In computing Garrison Operating Stock or Mount-Out, determine authorized levels by multiplying the replacement factor (column 11) times the quantity used per equipment (column 8) times the number of end items employed by the using organization or supported by the service organization times the authorized day level expressed in months and divide by 12. Specific formulas and examples are provided in the Marine Corps Order (MCO) P4400.79.
- (2) Revise, if warranted, the replacement factors used in initial stockage computations, as listed in column 11, after significant usage is experienced per guidelines of MCO 4400.32. Use the following formula for revising replacement factors based on actual usage where the symbol "W" represents the revised replacement factor, "X" represents actual usage experience (1 year), "A" represents the application per equipment, and "B" represents the number of equipments supported.

$$W = \frac{X}{A \times B}$$

- (3) Initial allowances for maintenance float items (recoverability codes "F", "H", and "D") for the Fleet Marine Force and appropriate post and stations are as furnished by Initial Issue Actions. Changes to maintenance replacement rates resulting from actual usage may require computation of maintenance float allowances by holding units. Any required recomputations of maintenance float allowances will be made per MCO P4400.82.
- (4) The replacement factor for same as (S/A) items is indicated upon the first appearance of the item in the major combination, component, or assembly.

**5-36. SECTION II.
ITEM NUMBER
CROSS-
REFERENCE**

Provide a cross-reference from RPL item numbers to part numbers and manufacturers' code numbers. Arrange in numerical sequence by RPL item number and include only those items listed in paragraph 5-35 which do not have an NSN. See figure 5-32 as an example.

**5-37. SECTION III.
NATIONAL
STOCK
NUMBER CROSS-
REFERENCE**

Provide a cross-reference from NSNs to RPL item numbers, part numbers, and manufacturers' code numbers. Arrange in NSN sequence and include only those items listed in paragraph 5-35 which have an NSN. See figure 5-33 as an example.

**5-38. SECTION IV.
PART NUMBER
CROSS-
REFERENCE**

Provide a cross-reference from part numbers to manufacturers' code numbers, RPL item numbers, and NSNs for all items listed in paragraph 5-35 for which part numbers are available. Arrange in alphanumeric sequence by part number. See figure 5-34 as an example.

This cross-reference is applicable to electronic equipment RPL's only. Include all circuit symbol numbers listed in paragraph 5-35 and cross-reference each circuit symbol number to its individual RPL item number.

**5-39. SECTION V.
CIRCUIT SYMBOL
NUMBER TO ITEM
NUMBER CROSS-
REFERENCE**

Provide illustrations of assemblies/subassemblies contained in this chapter. Key them to the RPL table. Locate the table for assembly/subassembly needed, then refer to figures listed in column four for location of each item. Types of parts location illustrations include exploded views, engineering drawings, when command approved, photographs, and sectional views, as applicable. Suitable parts location illustrations located in other chapters of the manual may be referenced. Illustrations must also conform to the following criteria:

**5-40. ASSEMBLY/
SUBASSEMBLY
ILLUSTRATIONS**

- a. Callouts. Items must be called out on illustrations by call-out leader, index number, or grid coordinates. Standard attaching hardware items (such as nuts, bolts, washers, screws) need not be called out or illustrated, except when they are on exploded views or are referenced in a procedure.

5-40.a. Callouts

See figure 3-1 as an example.

- b. Exploded Views. Arrange parts in an exploded view in correct, relative disassembly order. Show parts in proportional size. The spacing of parts must achieve maximum clarity and effective use of space. The relationship of parts must be indicated by the use of assembly lines. Break the main line of exploded parts into two or more groups for convenience of layout on the page. Use leader lines and index numbers to assist in locating parts.

5-40.b. Exploded Views

**5-40.c. Line Drawings
and Photographs**

- c. Line Drawings and Photographs. Use line drawings instead of photographs, unless permitted in the contract or order. Engineering drawings are acceptable if they meet the format and content requirements of this specification and the legibility requirements of MIL-M-38784.

**5-40.d. Printed Circuit
Board**

- d. Printed Circuit Board. Illustrate printed circuit boards foil side up. When printed wirings appear on both sides of the board, illustrate both sides. Outline all parts mounted on the board in black solid (front) or dashed line (rear) (even though mounted on the reverse side of the board). Clearly illustrate their connections to the printed wiring. If insufficient room exists, provide separate illustrations for top and bottom views. Label each part with the applicable reference designation. To facilitate parts location, provide a location grid and corresponding guide chart when more than 30 items are mounted on a board.

5-41. APPENDIX

Appendix

Type IA. manuals include two appendices as follows:

- a. Appendix A. List of Current Publications.
b. Appendix B. Appropriate Related Technical Information and Procedures (exclusive of administrative procedures).

Place appendices immediately after the last manual chapter. Capitalize and center appendix headings. Identify appendices by capital letters, e.g., "APPENDIX A, APPENDIX B." Consecutively number pages, paragraphs, illustrations, and tables in appendices. For example, "A-12" refers to the 12th page or paragraph of

Appendix A. "Figure A-12" refers to the 12th illustration in Appendix A. "Table A-12" refers to the 12th table in Appendix A.

Index

5-42. INDEX

Prepare an alphabetical index when the number of paragraphs exceeds 100. See figure 5-35.

TM 08444A-15/1

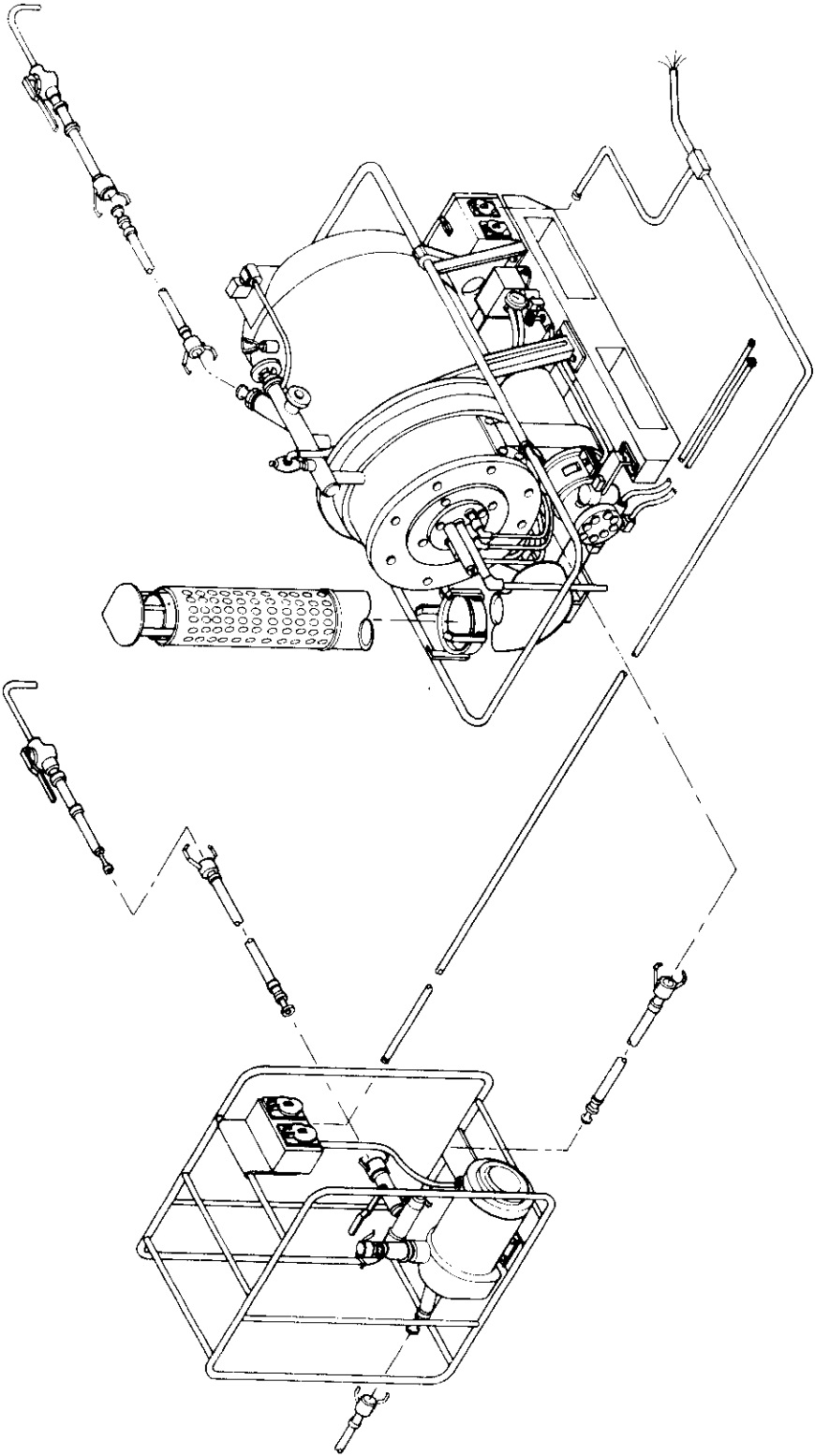


Figure 1-1. Hot Water Heater, Major Components

Figure 5-1. Sample of Equipment Illustration Showing Relationship of All Units

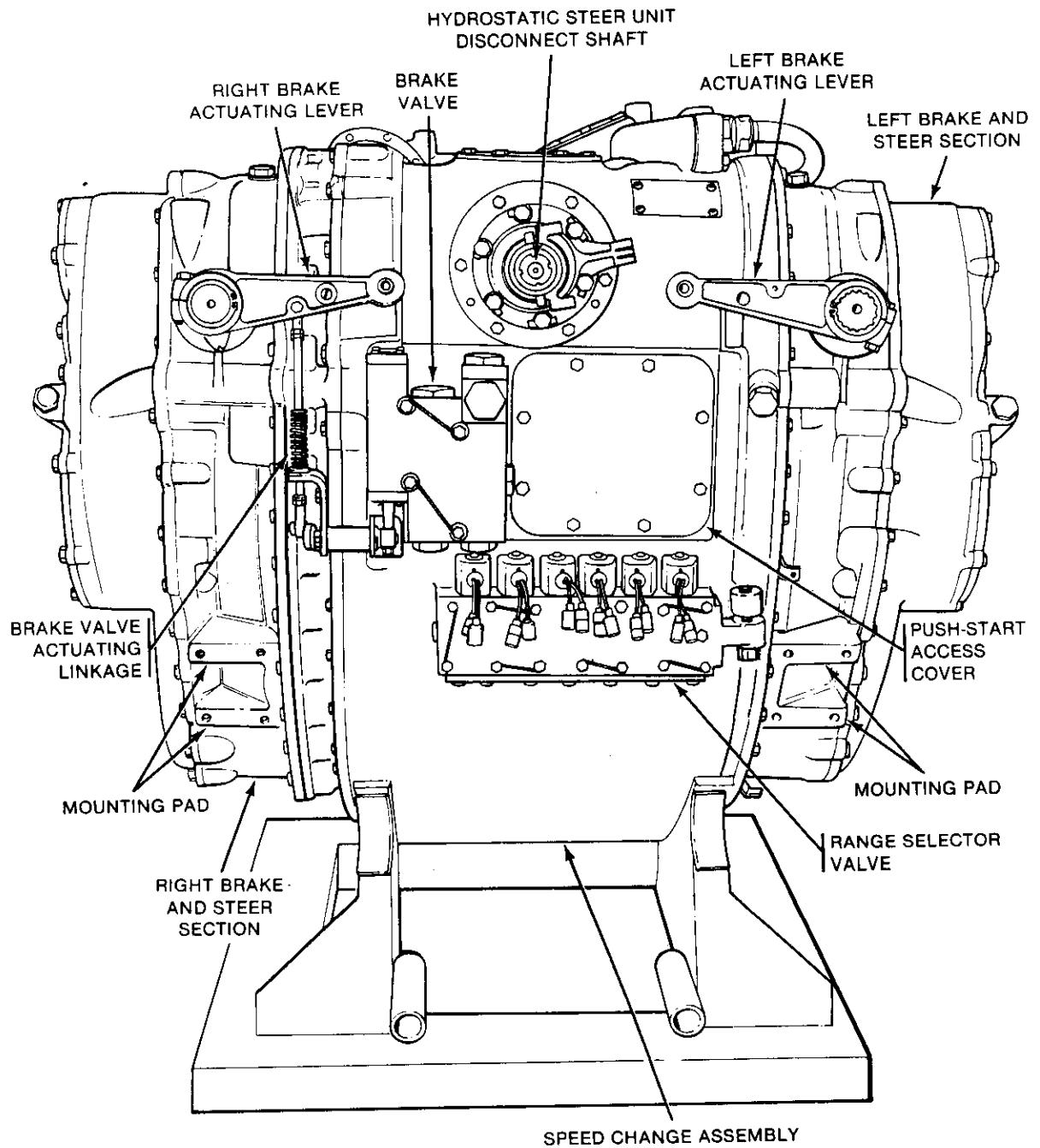


Figure 5-2. Sample of Major Parts of Component or Equipment

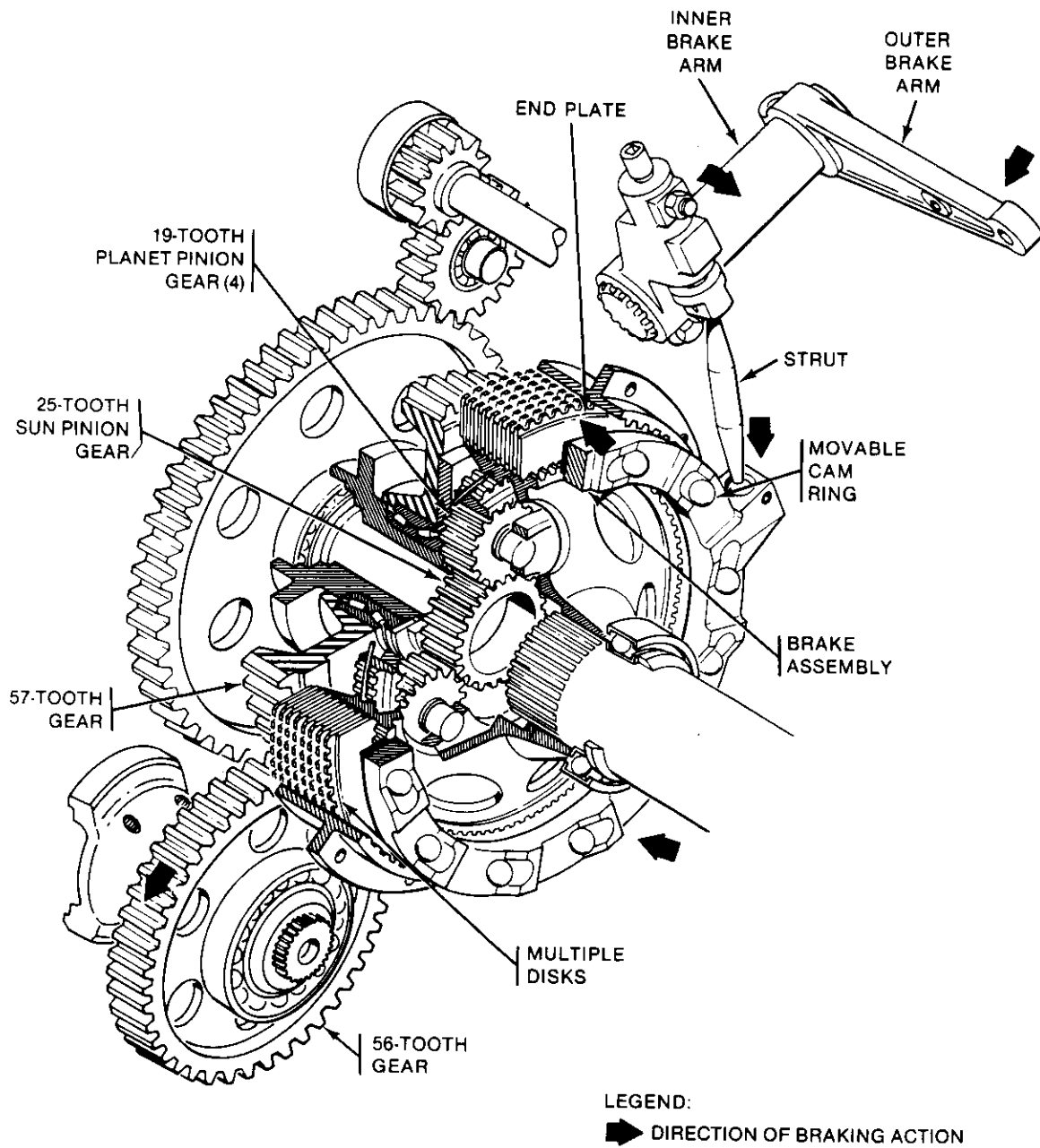


Figure 5-3. Sample of Interaction of Major Parts

3-12. SERVO VALVE (See figure 3-12). The servo valve gets mechanical signals from the winch control lever in the FAST control station. If the control lever is moved to the PAY OUT position, the servo valve gets the signal and positions the pump yoke to send pressure to the hydraulic motor to turn the winch drum in the PAY OUT direction. If the servo valve gets a signal to HAUL IN, the pump yoke is positioned so that the winch drum is turned to HAUL IN.

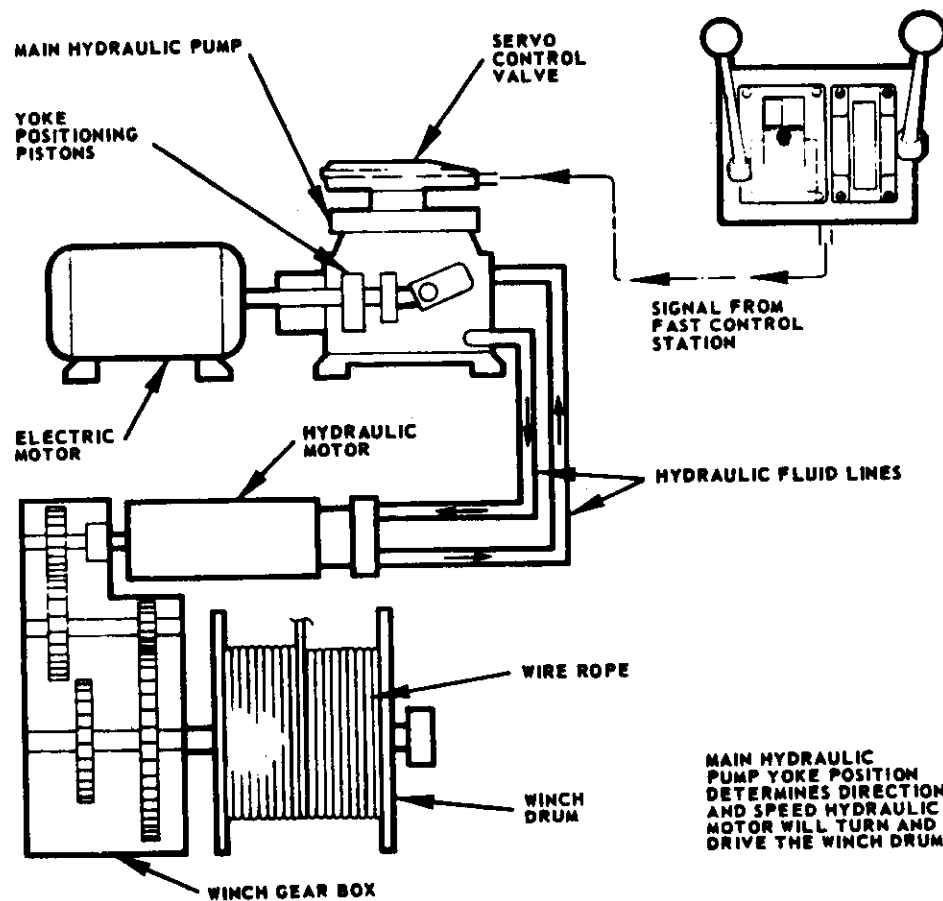


Figure 5-4. Sample of Functional Description Diagram

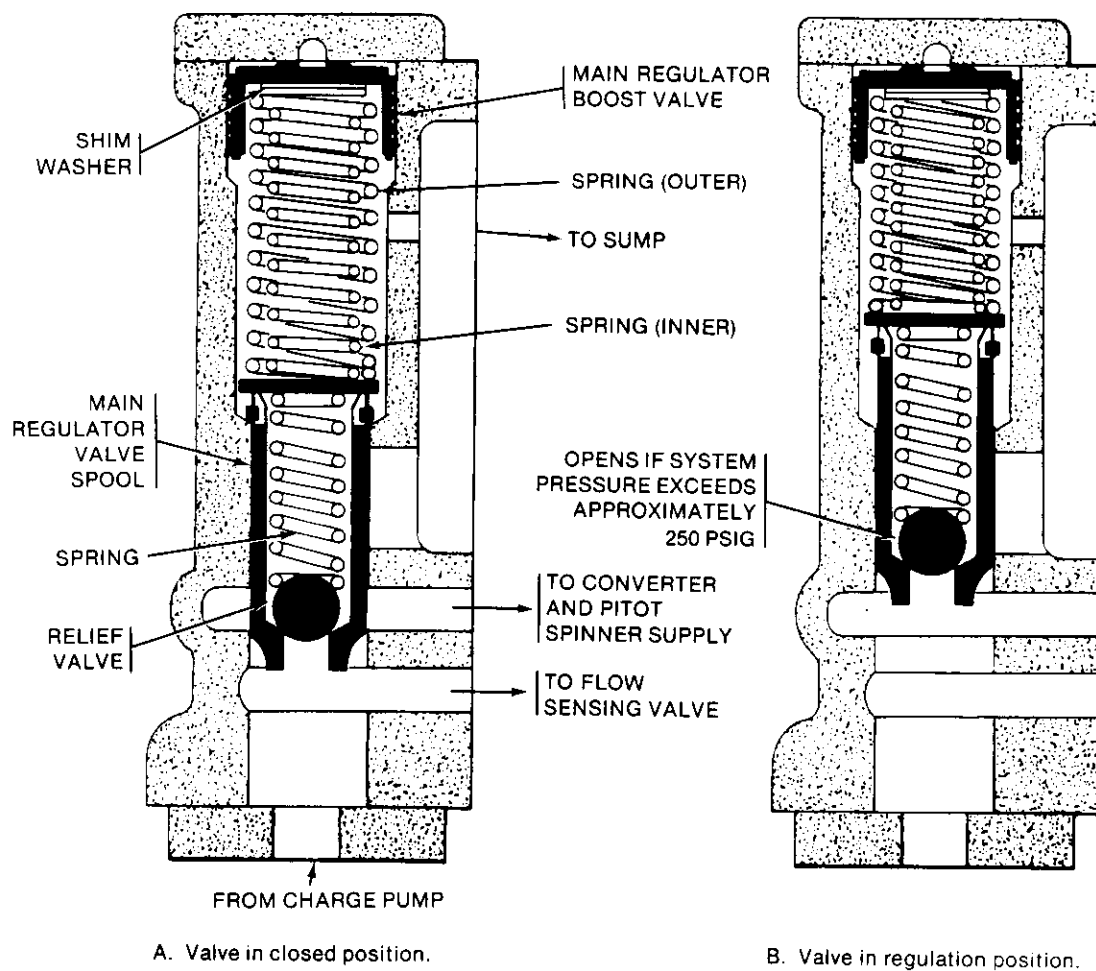


Figure 5-5. Sample of Equipment Inner Operation

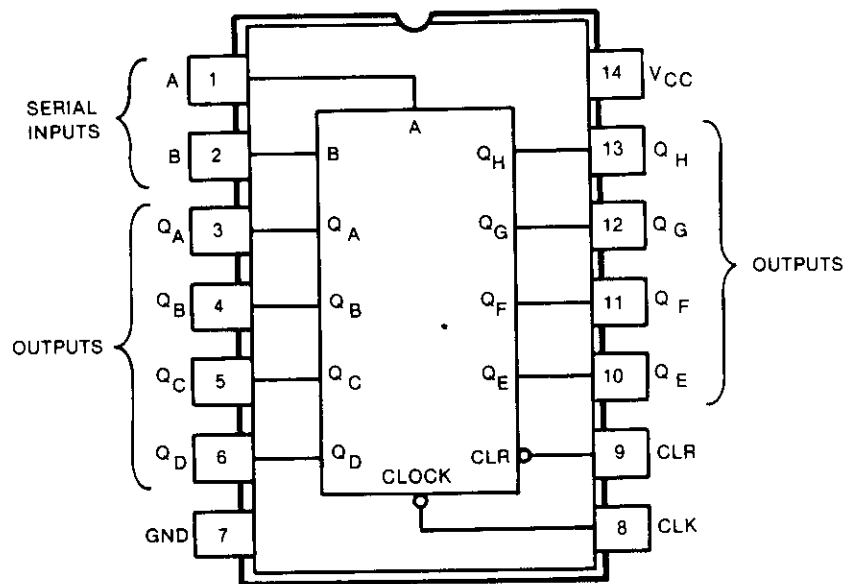


Figure 9-67. Integrated Circuit 54LS164.

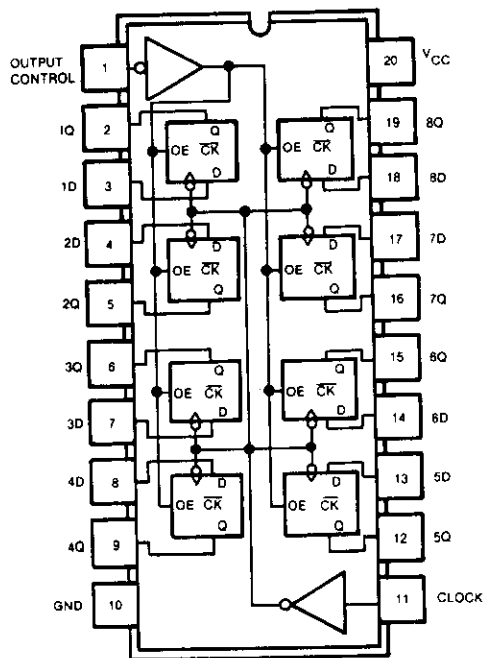
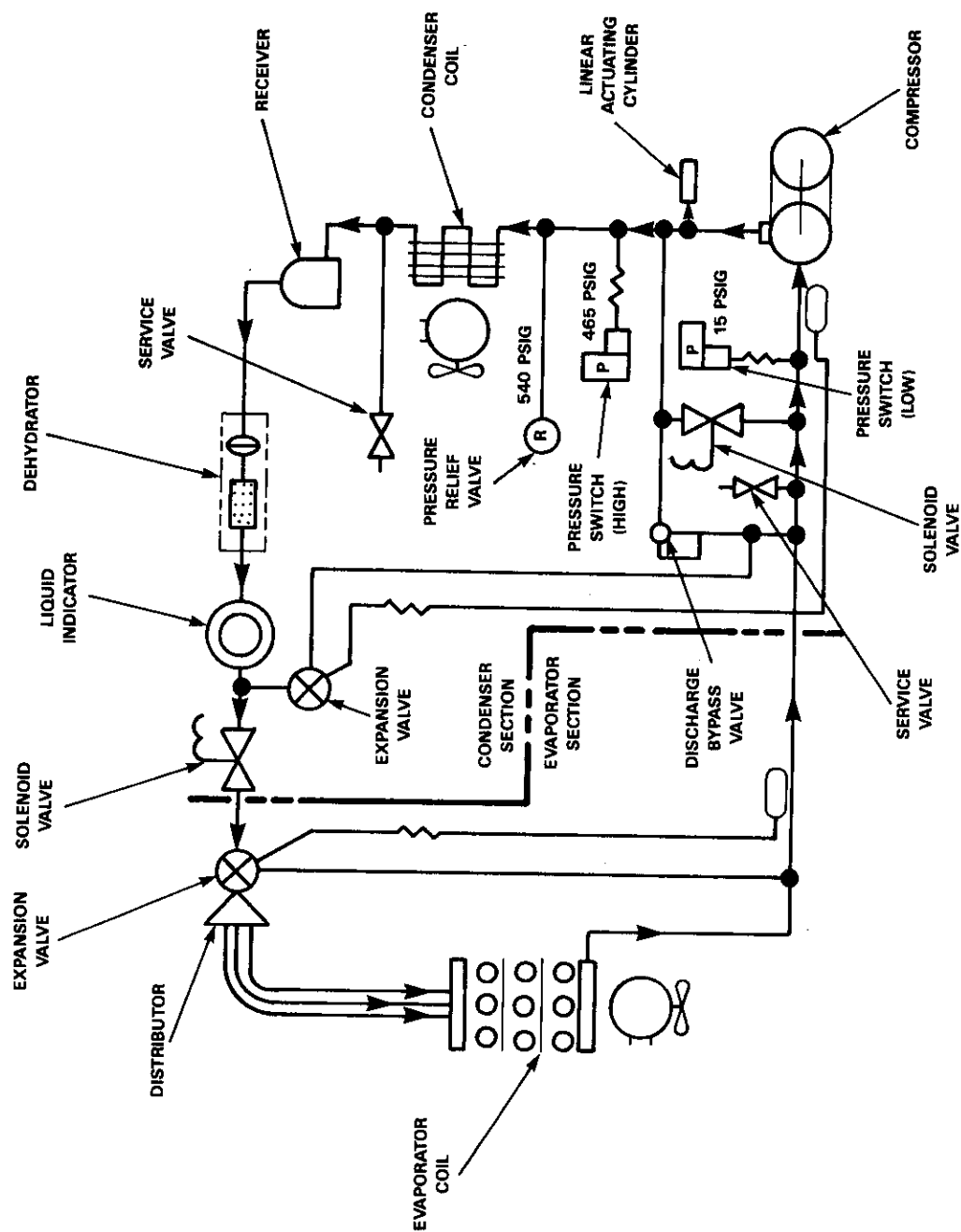


Figure 9-68. Integrated Circuit 54LS374.

Figure 5-6. Sample of Integrated Circuits and Micro-Miniature Capsules



AIR CONDITIONER REFRIGERATION DIAGRAM

Figure 5-7. Sample of Simplified Piping Diagram

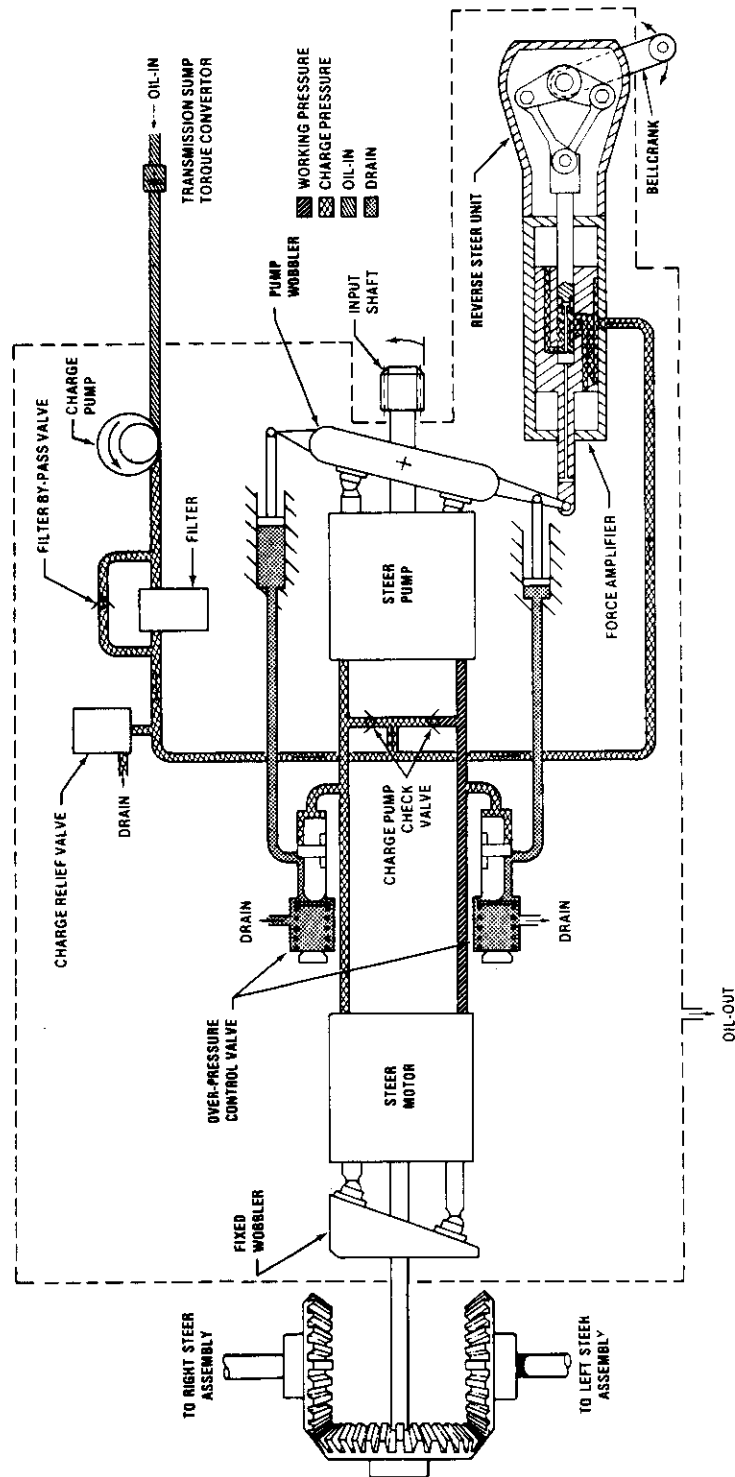


Figure 5-8. Sample of Mechanical Schematic Diagram

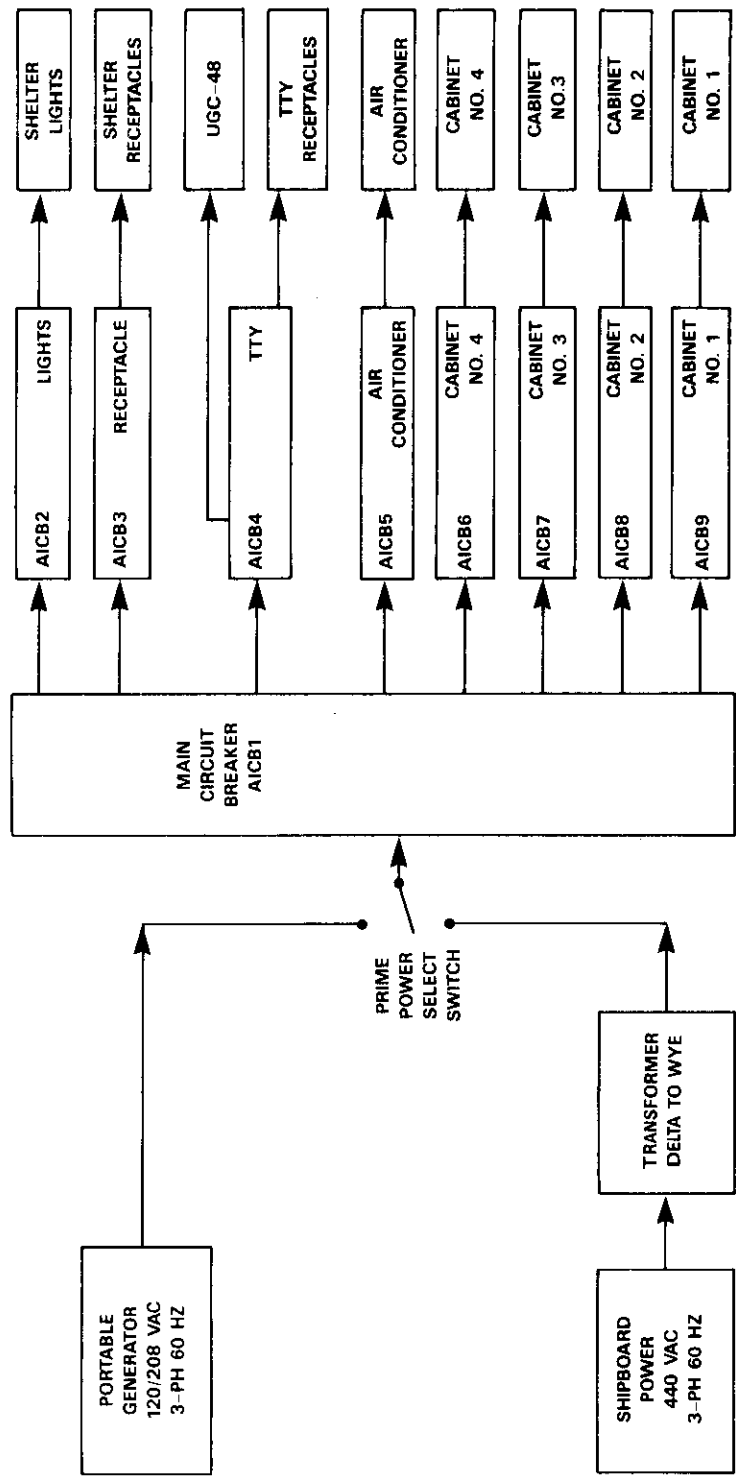


Figure 5-9. Sample of Functional Block Diagram

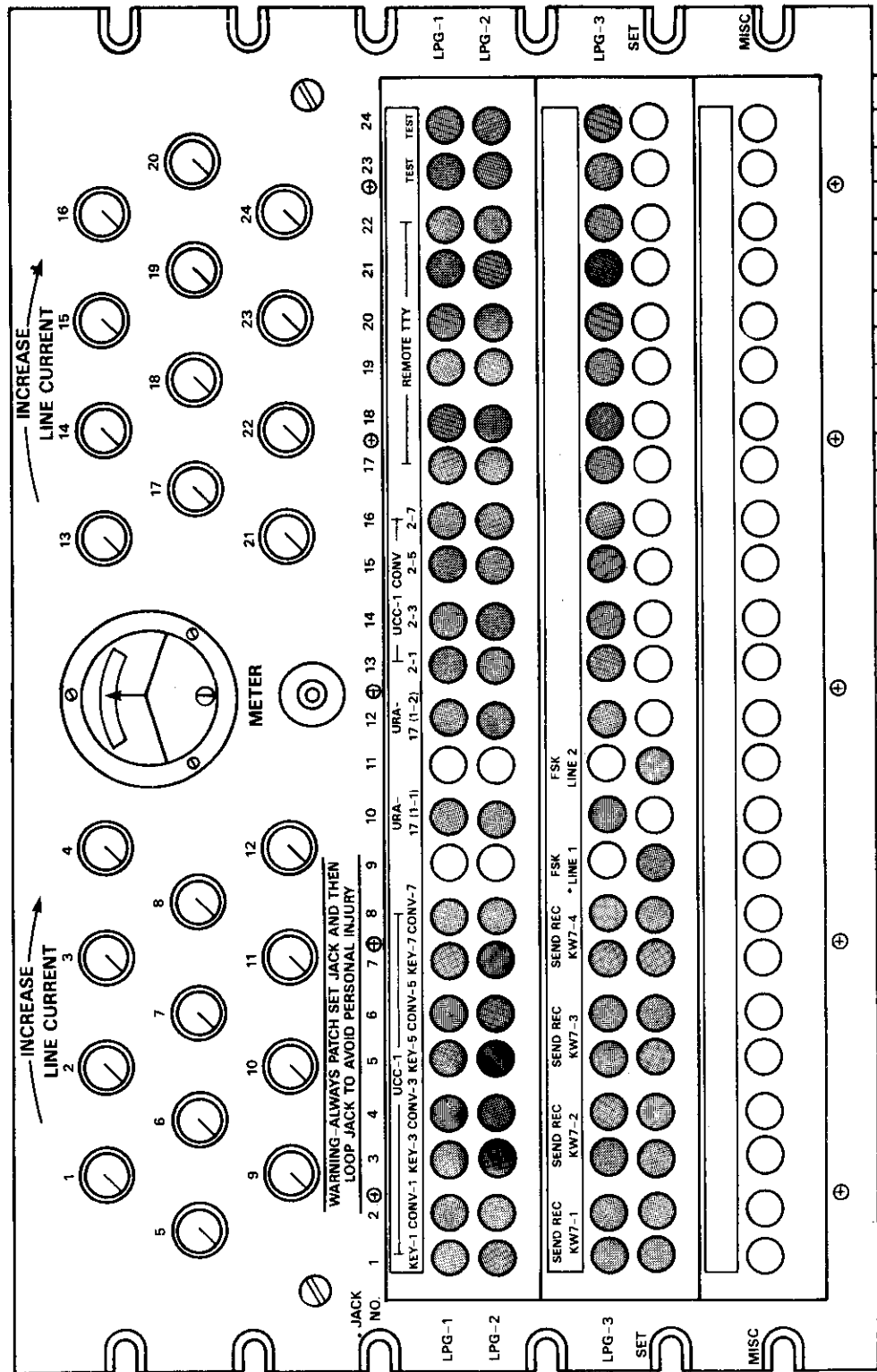


Figure 5-10. Sample of Operator's Controls and Indicators Illustration

Table 2-1. Power Distribution Panel Communication Central,
AN/TRC-171, Controls and Indicators

Key (Figure 2-1)	Control/Indicator Connector	Function
1	AC Voltage Voltmeter	Monitors 120 V input voltage.
2	Main Circuit Breaker	50 amp 3 pole protective device and ON-OFF switch for power to the shelter.
3	Receptacle Circuit Breaker (No. 1 and No. 2)	20 amp protective device and ON-OFF switch for power to Receptacles 1 and 2.
4	Lights Circuit Breaker	20 amp protective device and ON-OFF switch for power to shelter overhead lights and shelter blackout switch.
5	CAB No. 1 Circuit Breaker	20 amp protective device and ON-OFF power switch to cabinet No. 1.
6	CAB No. 2 Circuit Breaker	20 amp protective device and ON-OFF power switch to cabinet No. 2.
7	AN/URT 23 No. 2 Circuit Breaker	15 amp, 3 pole protective device and ON-OFF switch for power to AN/URT 23 No. 2.
8	AN/URT 23 No. 1 Circuit Breaker	15 amp, 3 pole protective device and ON-OFF switch for power to AN/URT 23 No. 1.
9	Receptacle Circuit Breaker (No. 3)	20 amp protective device and ON-OFF switch for power to receptacle No. 3.
10	Air Conditioner Circuit Breaker	50 amp, 3 pole protective device and ON-OFF switch for power to air conditioner.
11	Power Reset Switch	Used to reset AC voltage after an abnormal voltage input has been corrected.
12	Frequency Meter	Monitors 60 Hz input frequency.

Figure 5-11. Sample of Operator's Controls and Indicators Table

Table 2-5. Scheduled Maintenance Action Index

Maintenance Interval	Maintenance Action	References
<u>TELETYPEWRITER CENTRAL, AN/TGC-46</u>		
D	System Preoperation Checkout	TM 08610A-15
<u>Telegraph Terminal Set, AN/UCC-1D(V)</u>		
M	a. Clean and inspect.	TM 08059A-12
S	b. Verify diversity balance of each converter group.	TM 08610A-15
S	c. Test and adjust converter-discriminator balance.	TM 08610A-15
S	d. Test terminal keys.	TM 08610A-15
S	e. Adjust terminal telegraph keyer tone level.	TM 08610A-15
S	f. Test control attenuator output.	TM 08610A-15
<u>AN/UGC-77, AN/UGR-9</u>		
M	a. Clean, inspect and lubricate.	TM 08059A-12
Q	b. Test operating parameters of teletype-writer set.	TM 08610A-15
R	c. Clean, inspect, lubricate and adjust.	TM 08610A-15
<u>Teletypewriter (ASR), AN/UGC-48</u>		
Q	a. Clean, inspect and lubricate.	TM 08059A-12
R	b. Clean, inspect, lubricate and adjust.	TM 08610A-15
Q	c. Test operating parameters.	TM 08610A-15
<u>Comparator-Converter, AN/URA-17()</u>		
Q	a. Measure power supply voltages.	TM 08610A-15
Q	b. Test tuning indicator centering.	TM 08610A-15
Q	c. Test discriminator operation.	TM 08610A-15
Q	d. Test keyer function.	TM 08610A-15
W	e. Test interlocks and cleaning.	TM 08610A-15
<u>Transmitter Distributor, TT-603/UG</u>		
Q*	a. Clean, inspect and lubricate.	TM 08059A-12
Q	b. Test operating parameters of transmitter-distributor set.	TM 08610A-15
	* Perform quarterly or every 750 hours of equipment operation, whichever occurs first.	

Figure 5-12. Sample of Scheduled Maintenance Action Index

Table 0-0. Troubleshooting

Malfunction	Probable Cause	Possible remedy
MAIN ENGINE		
1. Engine fails to crank.	a. Master switch off. b. Batteries discharge.	a. Make sure master switch is turned on (para. 4-5). b. Recharge or replace batteries (para. 3-24 and 3-25).
2. Engine cranks but fails to start.	a. Fuel tank pump not operating. b. Water in fuel tanks. c. Engine cranks slowly. d. Engine underprimed.	a. Repair or replace pump as necessary. b. Drain tanks (para. 3-15) and refill with fresh fuel. c. Wrong grade of oil for prevailing temperature. Drain engine and refill with correct grade of oil (para. 3-19). d. Check operation of priming system. Look for plugged nozzles in cylinders and for broken or damaged lines or filters.
3. Engine backfires.	a. Water in fuel tanks. b. Moisture in magnetos or cracked internal parts.	a. Drain tanks (para. 4-25) and refill with fresh fuel. b. Wipe magnetos dry. Replace damaged parts.
AUXILIARY GENERATOR ENGINE		
1. Engine will not start.	a. Cylinder flooded. b. Faulty ignition.	a. Turn off magneto switch, open throttle wide, and crank engine intermittently. b. Clean, adjust, or replace breaker points. Clean, adjust, or replace spark plug. Replace condenser. Retime ignition.
2. Engine does not develop full power.	a. Dirty carburetor air cleaner. b. Choked muffler.	a. Remove air cleaner and clean (para. 4-40). b. Clean or replace muffler.

Figure 5-13. Sample of Troubleshooting Table

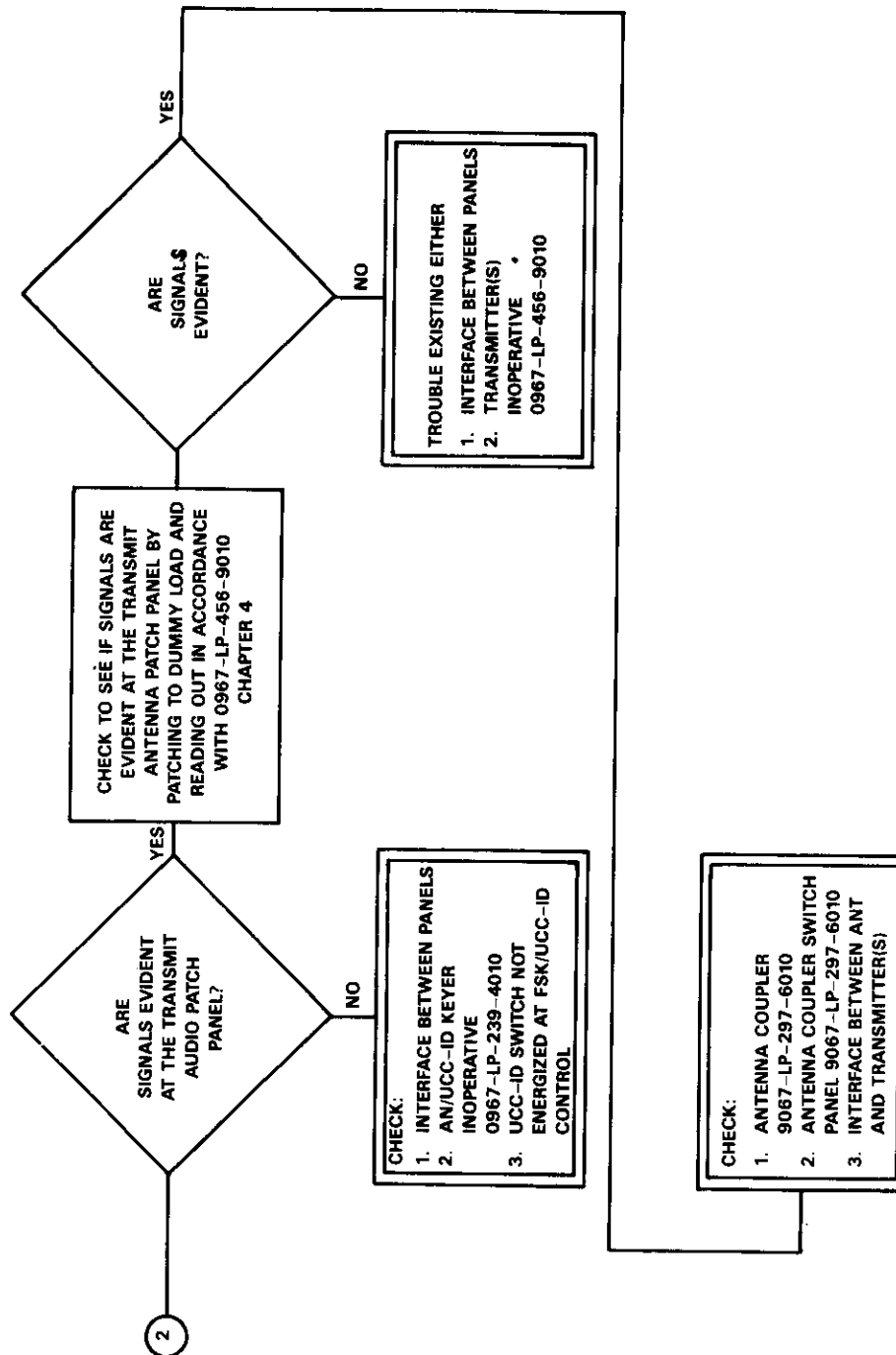


Figure 5-14. Sample of Fault Logic Diagram

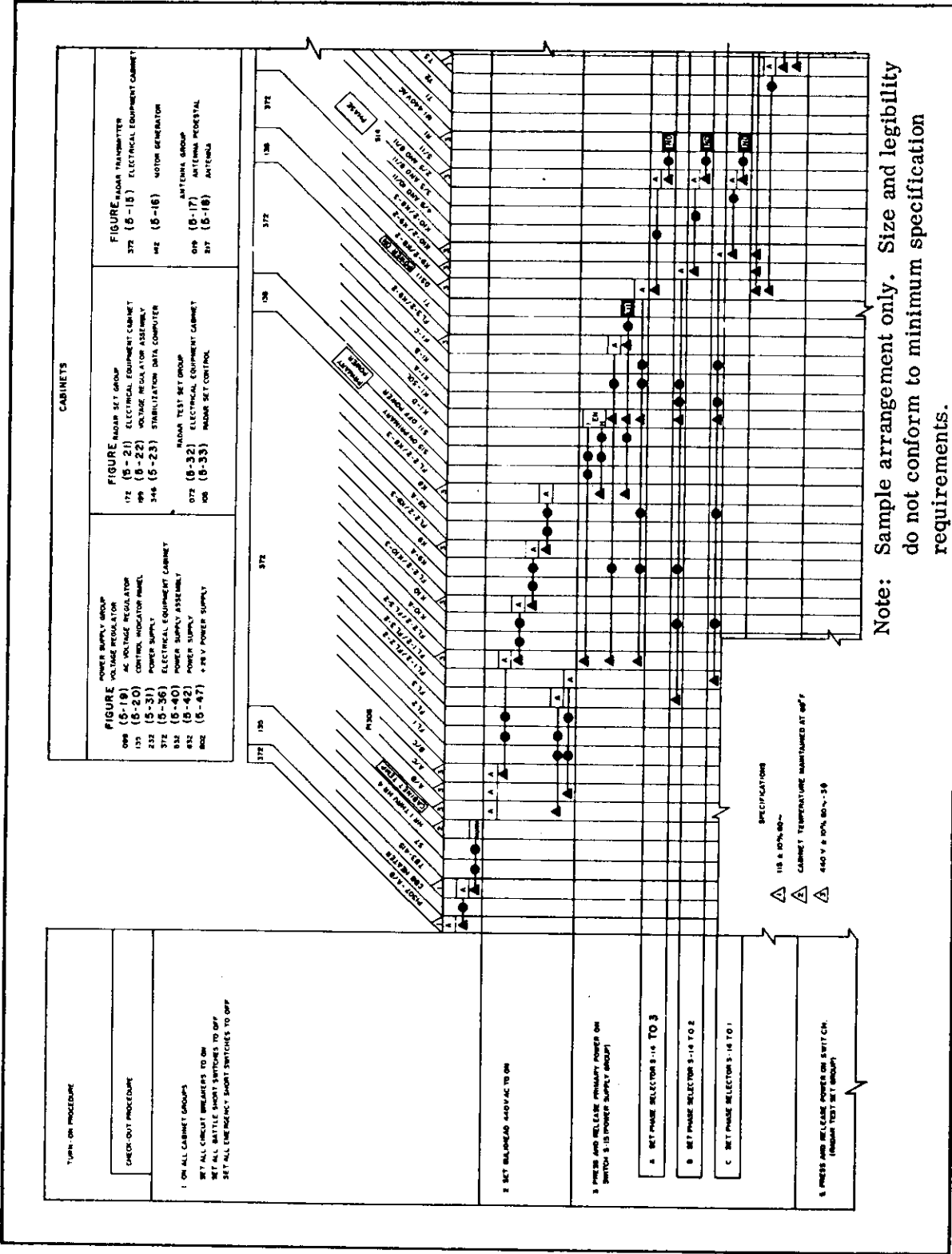


Figure 5-15. Sample of Troubleshooting - Maintenance
Dependency - Matrix Chart

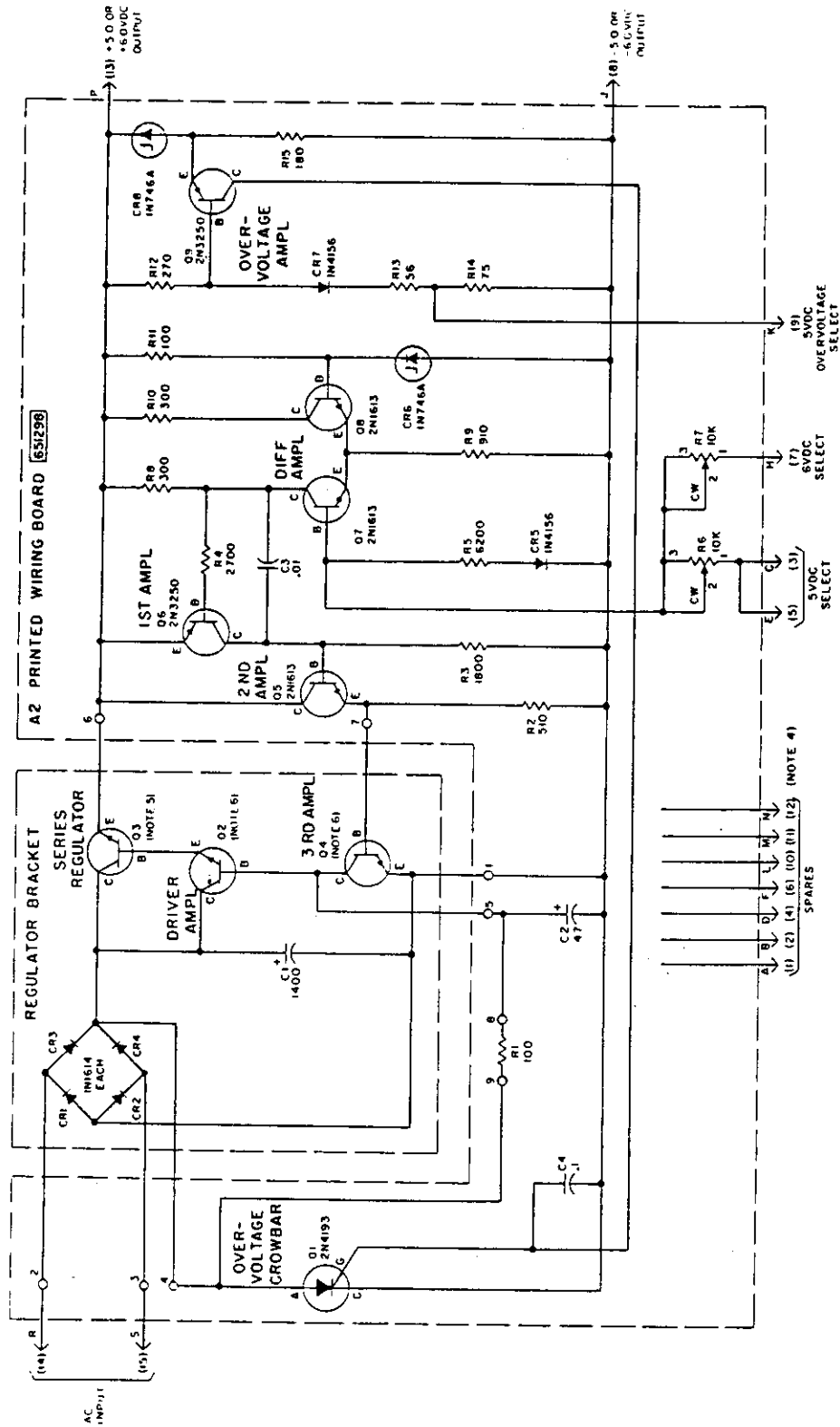


Figure 5-16. Sample of Printed Wiring Assembly

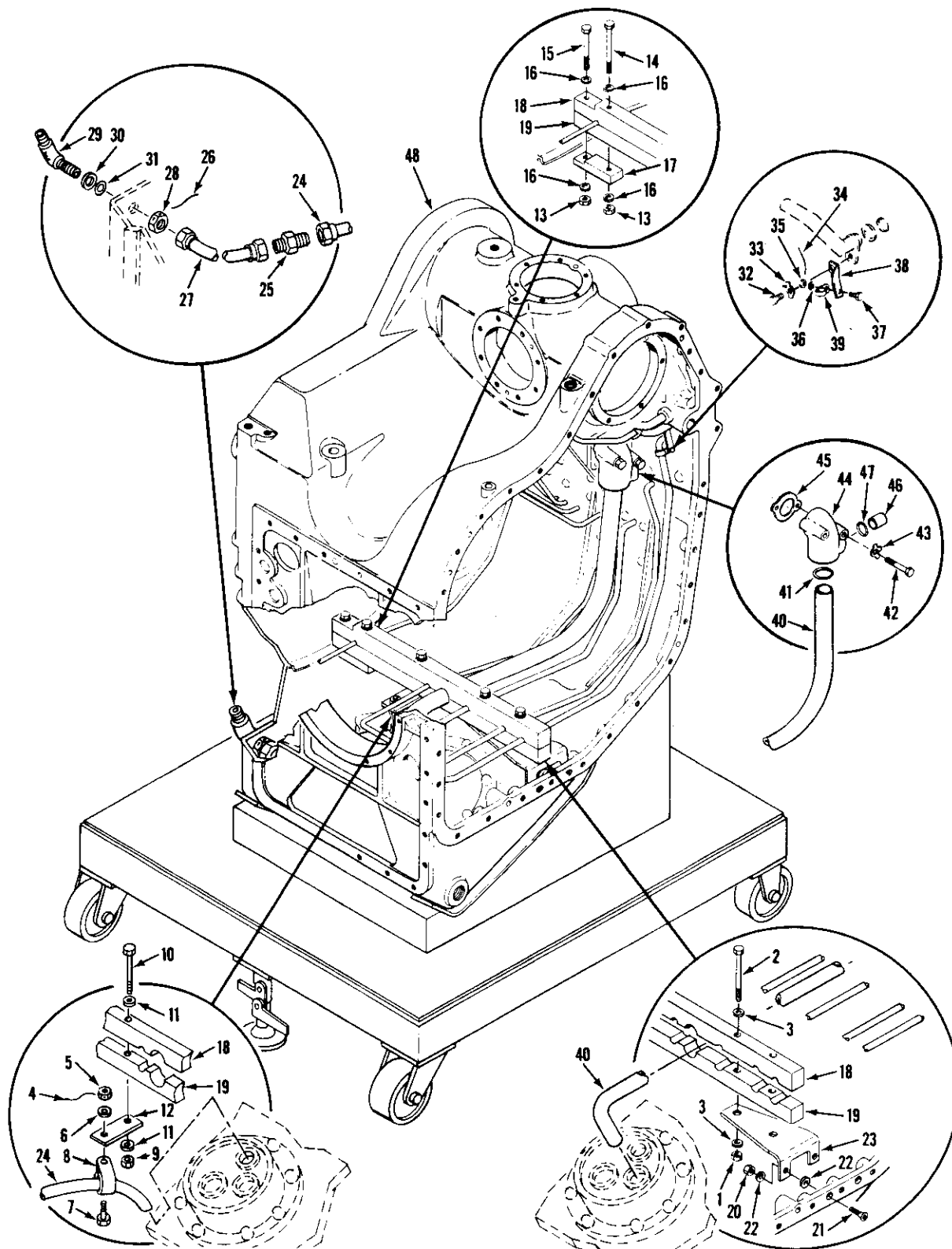
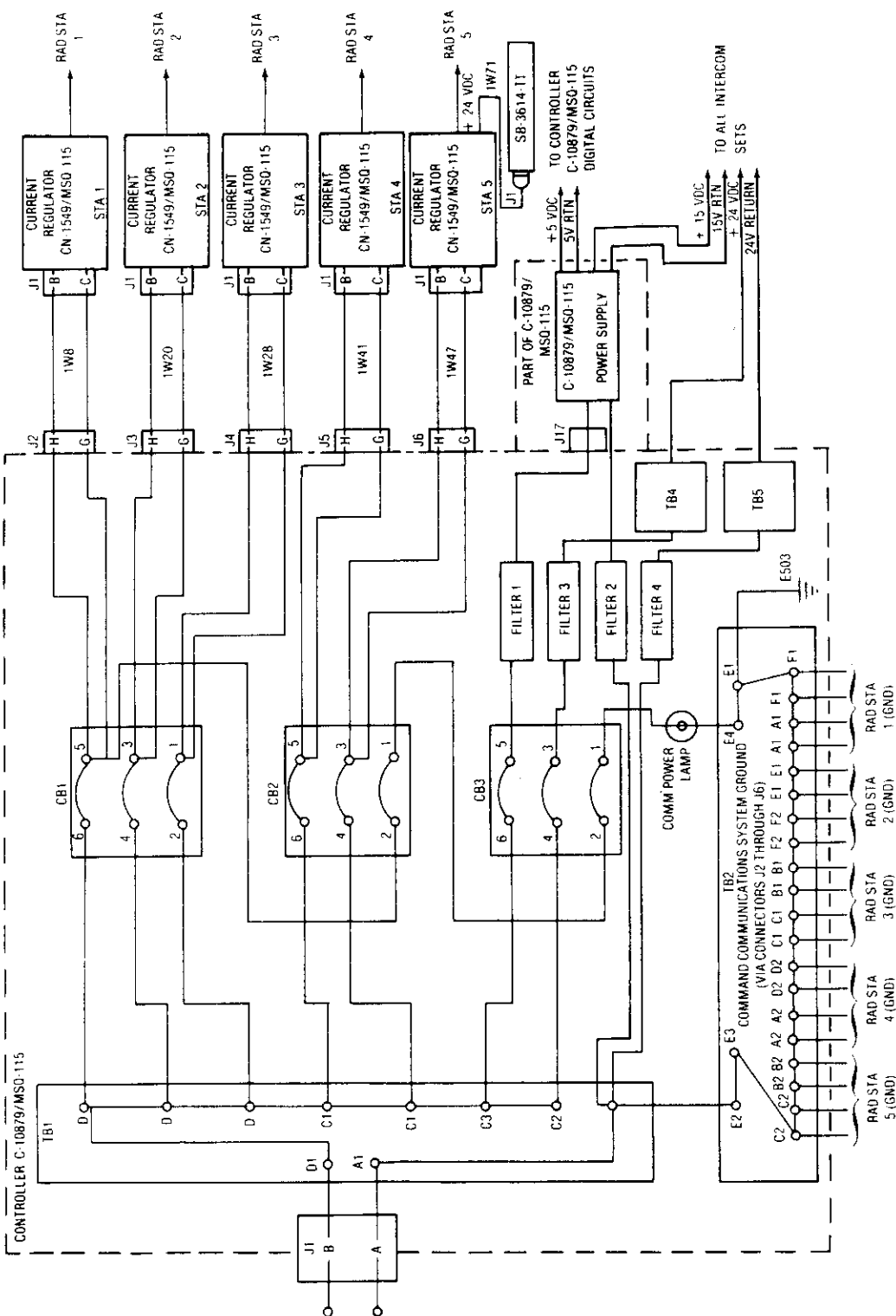


Figure 5-17. Sample of Master Assembly Drawing



NOTE: ALL SWITCHES AND RELAY CIRCUITS
ARE SHOWN IN OPERATING POSITIONS

Figure 5-19. Sample of Power Distribution Diagram

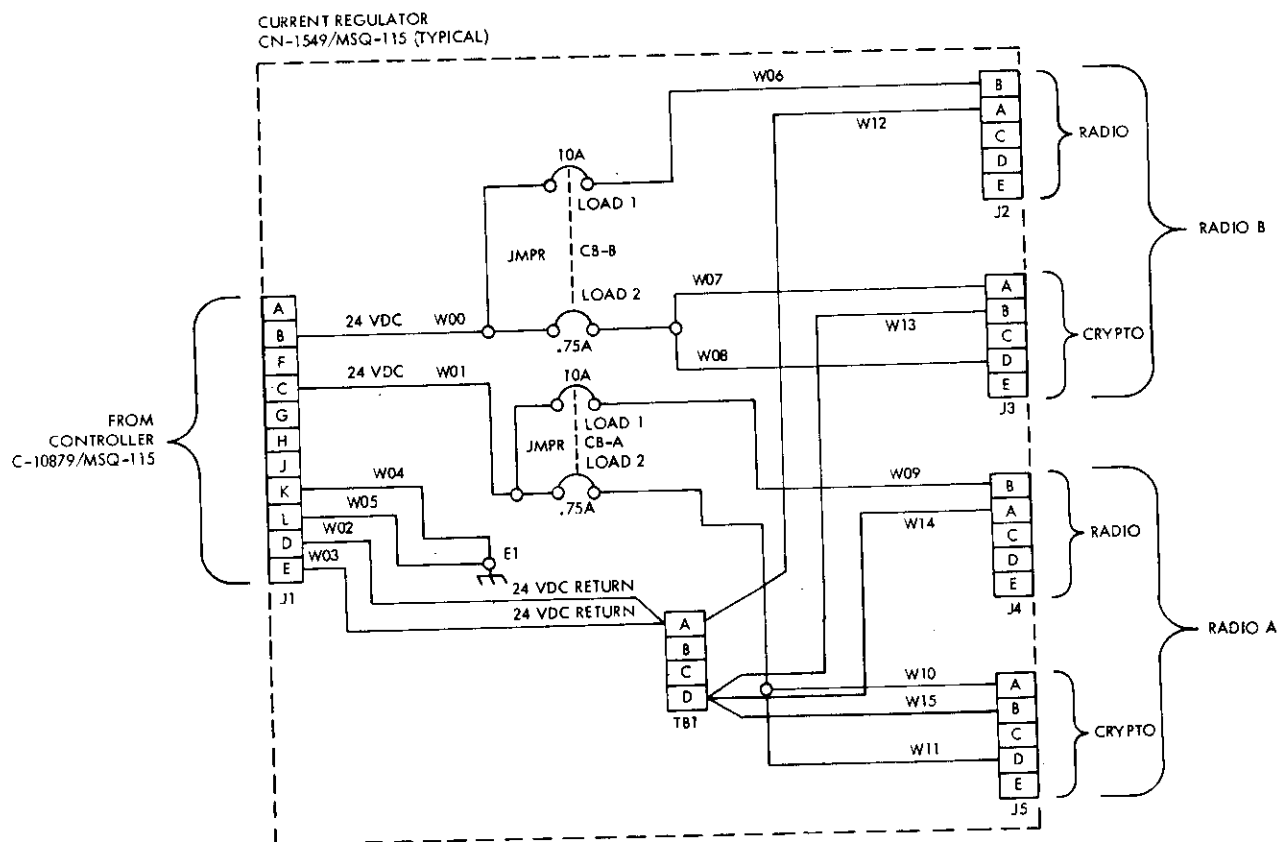


Figure 5-20. Sample of Maintenance Schematic Diagram

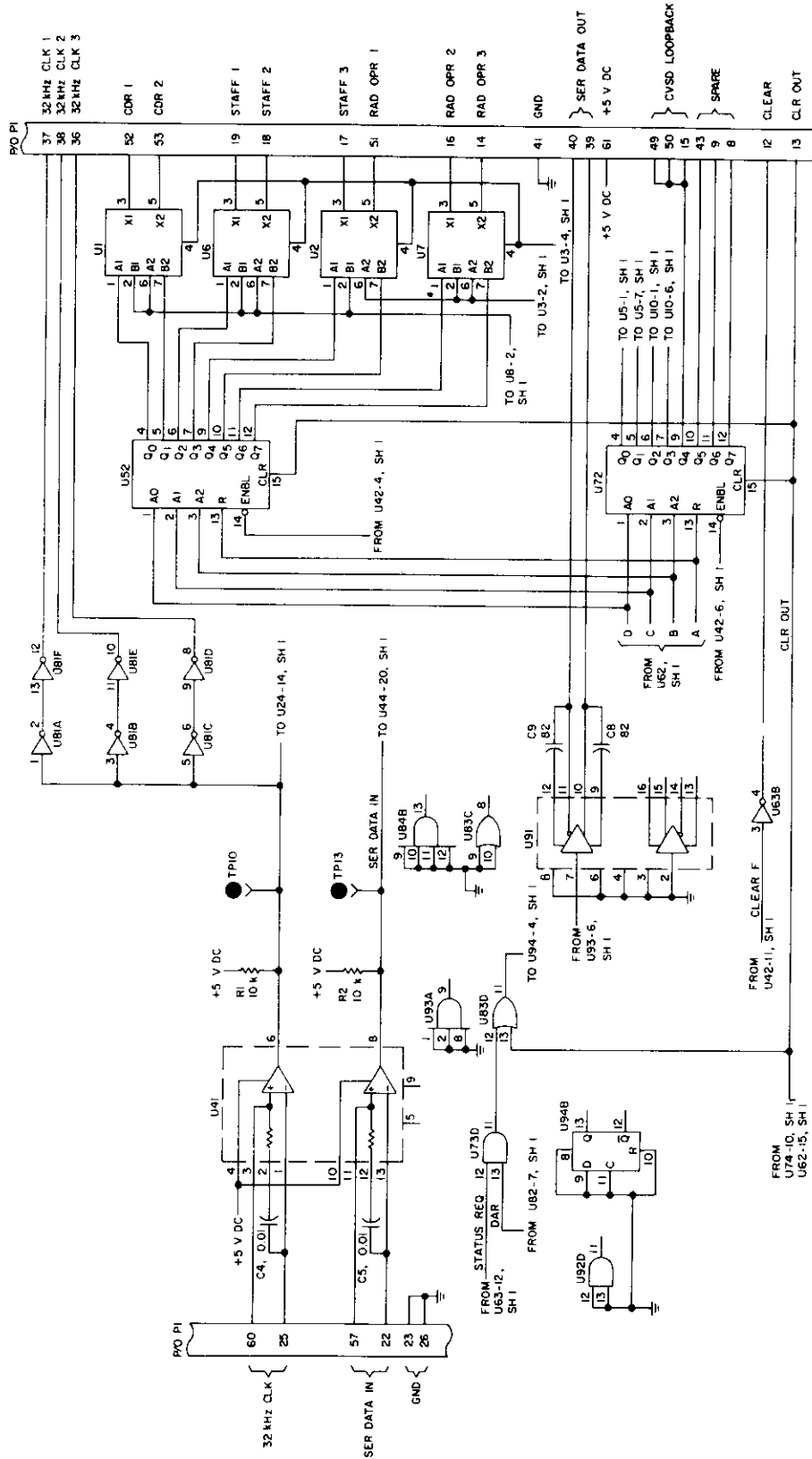


Figure 5-21. Sample of Logic Diagram

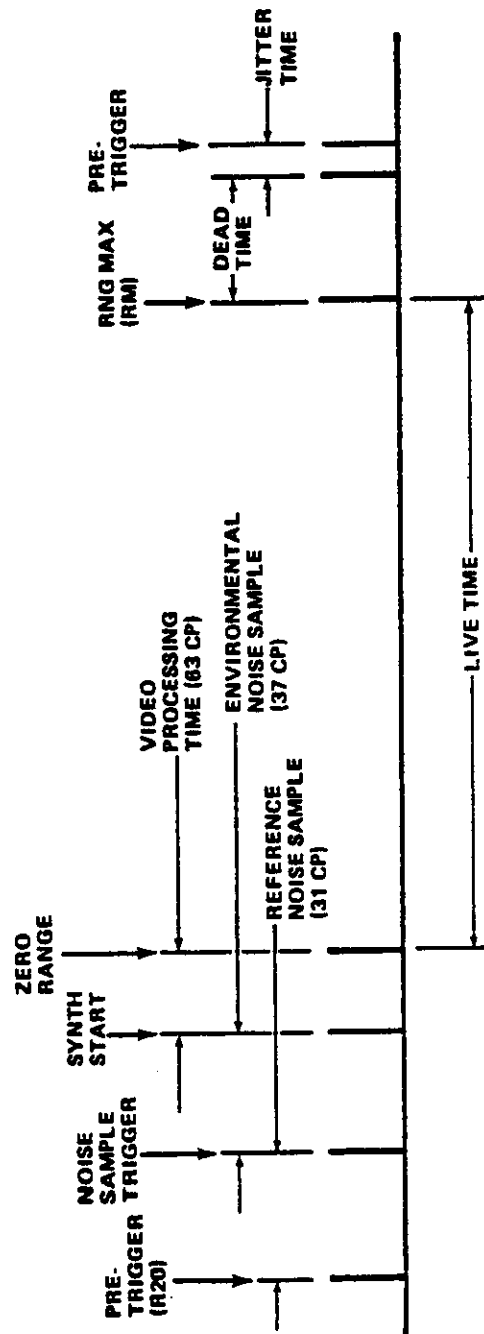


Figure 5-22. Sample of Control Cycle Diagram

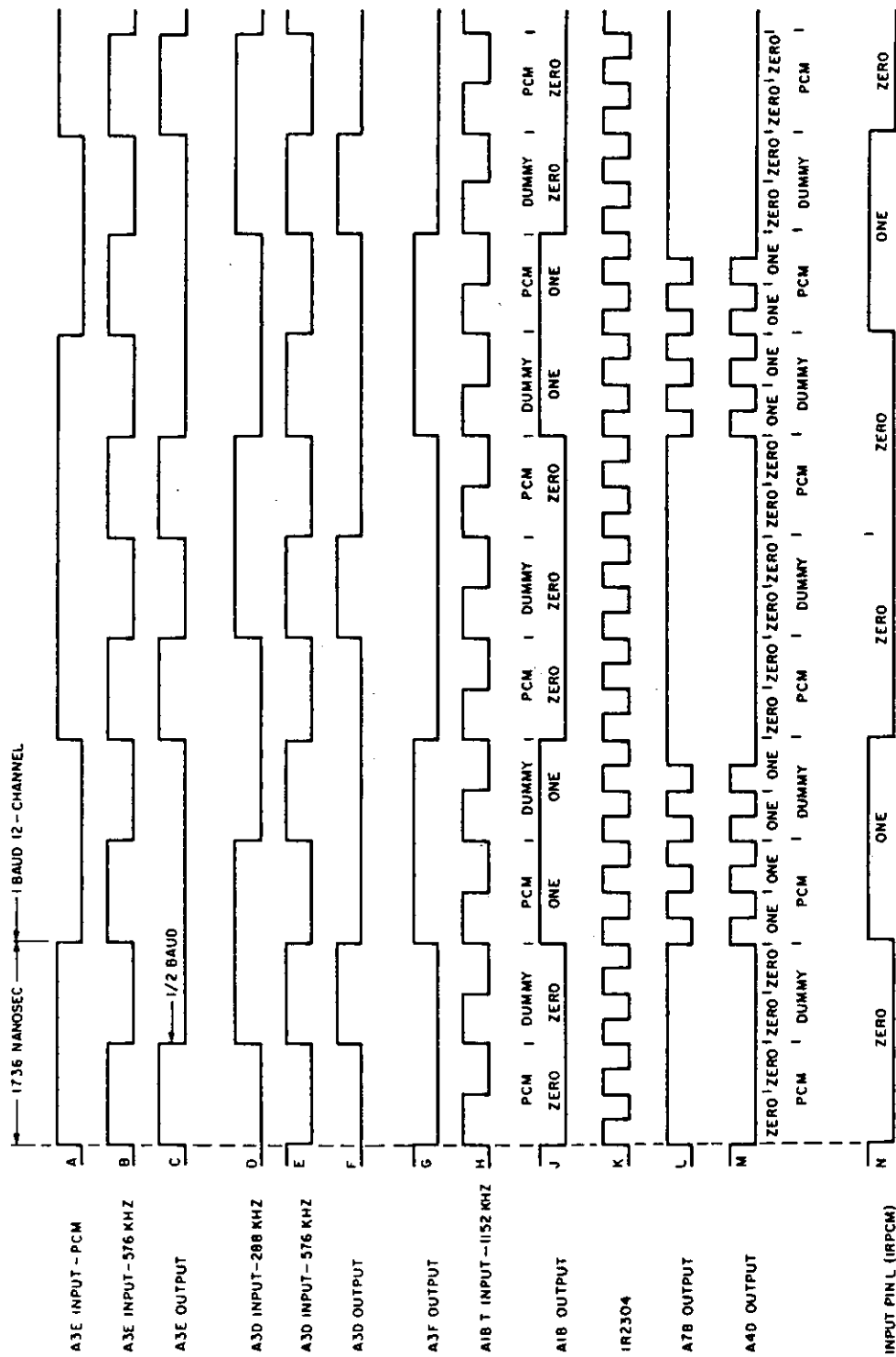


Figure 5-23. Sample of Timing Circuit Diagram

XYZ ROUTINE - PROGRAM LISTING							
LOC	MEMORY CONTENTS	LABEL	ORD	ADR	MOD	CONSTANT	NOTES
01443	000330700		FRS	30700			
01447	015101457		TMI	01457			
01453	034706277		TRA	06277			
01457	000077632		GET	37632			
01463	034706403		ORG	06403			
			ORG	06103			
06103	001037632	A1	STO	TEMPR	1		SAVE INSERTED NUMBER
06107	035106123		TMI	A3			/-/ NEGATIVE INSERT
06113	014077763	A2	GET	ONE			KEY FOR FIX RESET
06117	035035357		STO	KTYPF			TYPE OF RESET KEY
06123	000077760	A3	GET	ZERO			
06127	035037633		STO	TEMPR	2		CLEAR RESET /NRS/ KEY
06122	000077632		GET	TEMPR	1		
06137	004706147		TRA	SUB 1			GO TO RESET NUMBER SUBROUTINE
06143	000706327		TRA	A14			
06137	055437634	SUB 1	STV*	TEMPR	3		ENTRANCE - RESET NUMBER SUBRTN
06153	034313700	A4	PRS	1			
06157	035106243		IMI	RE13			CHECK LAST BCD BIT FOR SIGN
06163	034313700	A5	PRS	1			
06167	035106213		TMI	**5			CHECK 2ND BCD BIT FOR SIGN
06173	034333600	A6	FRS	2			CHECK 3RD AND 4TH BITS
06177	002206177		TMI	OUT			
06203	034077633	A7	GET	TEMPR	2		TEMPORARY RESET KEY
06207	005737634		TRA	TEMPR	3		EXIT - RESET NUMBER SUBROUTINE
06213	005077766	A8	EXT	MAXNO			
06217	034333600	FRS	FRS	2			CHECK 3RD AND 4TH BITS
06223	002206277		TMI	OUT			
06227	044041030	A9	GET			020000000	KEY TO RESET 2
06233	005477633	A10	ADD	TEMPR	2		
06237	005737344		TRA	TEMPR	3		EXIT - RESET NUMBER ROUTINE
06243	034313700	RE13	PRS				
06247	035106303		TMI	RE3			CHECK 2ND BIT FOR SIGN
06253	034077766	A11	EXT	MAXNO			
06257	034333600		FRS	2			CHECK 3RD AND 4TH BITS
06263	001106277		TMI	OUT			
06267	034077762	A12	GET	HALF			KEY TO RESET 1

Figure 5-24. Sample of Coding Instructions Sheet

APRIL 1984

SL-4-04485B

PCN 124 044851 00

MARINE CORPS STOCKLIST



REPAIR PARTS LIST

FOR

YOKE, TOWING AND LIFTING

FOR

AMPHIBIOUS ASSAULT FUEL SYSTEM

TAMCN B27302E

NSN 8110-00-856-6243

Figure 5-25. Sample Front Cover of Marine Corps Stocklist

ITEM IDENTIFICATION LISTING									
1 ITEM NO.	2 M O D E L	3 NATIONAL STOCK NUMBER	4. REF DESIG FIG-KEY	5 I N D	6 ITEM IDENTIFICATION	7 UNIT OF MEAS	8 QUANTITY		9 SMR CODE
							(A) PER APPL	(B) PER EQUIP	
1		8110-00-856-6243	FIG 1	A	YOKE, TOWING AND LIFTING REPAIR PARTS YOKE ASSEMBLY	EA			
2		5310-00-411-4385	002-012	B	NUT, SELF-LOCKING, HEXAGON, 0.500-13 UNC, 0.610 H, 0.752 IN WAF	EA	2	2	PAOZZ
3		5310-00-406-7240	002-008	B	NUT, SELF-LOCKING, HEXAGON, 0.625-11 UNC, 0.766 H, 0.940 IN WAF	EA	2	2	PAOZZ
4		5310-00-241-6609	002-009	B	NUT, SELF-LOCKING, HEXAGON, 0.750-10 UNC, 0.891 H, 1.064 IN WAF	EA	2	2	PAOZZ
5		5305-00-727-6804	002-011	B	SCREW, CAP, HEXAGON HEAD, S, 0.500-13 UNC, 1.440 LG, 1.750 IN FSTNR LG	EA	2	2	PAOZZ
6		5305-00-941-3579	002-007	B	SCREW, CAP, HEXAGON HEAD, S, 0.625-11 UNC, 1.725 LG, 1.750 IN FSTNR LG	EA	2	2	PAOZZ
7		5305-00-576-7188	002-002	B	SCREW, CAP, HEXAGON HEAD, S, 0.750-10 UNC, 2.000 LG, 2.500 IN FSTNR LG	EA	2	2	PAOZZ
8		4030-00-948-7315	002-005	B	HOOK, CHAIN, S, 0.120 DIA WIRE, 1.438 IN LG	EA	4	4	PAOZZ
9		4010-00-228-9933	002-004	B	CHAIN, WELDLESS, BRASS, 435 LBS BREAKING STRENGTH, 0.035 IN THK	FT	2	2	PAOZZ
10		3940-00-175-7677	002-001	B	LEG, CONNECTING, STEEL TUBING, 1.500 OD, 0.188 IN WALL THK	EA	2	2	PAOZZ
11		3940-00-168-6517	002-003	B	LEG, UPPER, S, 1.500 OD, 0.188 IN WALL THK	EA	2	2	PAOZZ
12		3940-00-175-3591	002-010	B	BRACE, S, RECT, 26.000 LG, 1.500 W 0.500 IN THK, 4 HOLES	EA	2	2	PAOZZ
13		5340-00-849-7494	002-006	B	PIN, QUICK RELEASE, S, 0.640 IN HD DIA, W/ATTACHING RING	EA	2	2	PAOZZ

Figure 5-26. Sample of Item Identification Listing

FEDERAL SUPPLY CODES FOR MANUFACTURERS			
CODE	MANUFACTURER	CODE	MANUFACTURER
19207	U.S. ARMY TANK-AUTOMOTIVE MATERIEL READINESS COMMAND TACOM WARREN, MI 48070	84256	AVIBANK MFG INC 210 S VICTORY BLVD P O BOX 391 BURBANK, CA 91503
81348	FEDERAL SPECIFICATIONS PROMULGATED BY GENERAL SERVICES ADMINISTRATION WASHINGTON, DC	96906	MILITARY STANDARDS PROMULGATED BY MILITARY DEPARTMENTS UNDER AUTHORITY OF DEFENSE STANDARDIZATION MANUAL 4120.3-M
81349	MILITARY SPECIFICATIONS PROMULGATED BY MILITARY DEPARTMENTS/AGENCIES UNDER AUTHORITY OF DEFENSE STANDARDIZATION MANUAL 4120.3-M	97403	U. S. ARMY MOBILITY RESEARCH AND DEVELOPMENT CENTER FORT BELVOIR, VA 22060

Figure 5-27. Sample of Federal Supply Codes for Manufacturers

<u>Code</u>	<u>Relationship</u>
"A"	End item
"B"	Component; attaching parts for component or detail parts of the end item not contained in a component
"C"	Assembly; attaching parts for assembly or detail parts of component not contained in a component
"D"	Subassembly; attaching parts for subassembly or detail parts of assembly not contained in subassembly
"E"	Detail parts of subassembly
"F"	And so forth

Figure 5-28. Relationship of Indenture Code Letters

(1) <u>Source</u>	(2) <u>Maintenance</u>		(3) <u>Recoverability</u>
	<u>Use</u>	<u>Repair</u>	
PA	F	F	A
PB	F	H	H
PC	O	Z	Z
AF	F	Z	Z
MF	F	F	F
KF	H	Z	Z
XA	F	Z	Z
XB	O	F	F
XC	H	Z	Z

Figure 5-29. Sample of Source Maintenance Recoverability Codes

SOURCE CODES

CodeApplication/Explanation

Source codes are assigned to support items to indicate the manner of acquiring the item for maintenance or overhaul of end items. Source codes are entered in the first and second position of the SMR code.

SERIES A: ASSEMBLE, COMPLETE ASSEMBLY NOT STOCKED

Code "A" entered in the first position of the source code applies to items that are not procured as assemblies but are assembled within the Marine Corps prior to installation. The code entered in the second position designates the lowest echelon authorized to assemble the item. All the parts used in the assembly will be "P" coded.

AO	Assemble at organizational maintenance 2nd echelon level.
AF	Assemble at intermediate maintenance 3rd echelon level.
AH	Assemble at intermediate maintenance 4th echelon level.
AD	Assemble at depot maintenance 5th echelon level.

SERIES K: ITEMS OF A KIT, NOT PURCHASED SEPARATELY

KD	An item of depot overhaul/repair kit and not purchased separately. Depot kit defined as a kit that provides items required at the time of overhaul or repair.
KF	An item of a maintenance kit and not purchased separately. Maintenance kit defined as a kit that provides an item that can be replaced at organizational or intermediate levels of maintenance.
KB	Items included in both a depot overhaul/repair kit and a maintenance kit.

Figure 5-30. Definitions and Application of Source Maintenance
Recoverability Codes (Sheet 1 of 6)

SOURCE CODES (Continued)

CodeApplication/Explanation**SERIES M: MANUFACTURE, PARTS NOT PROCURED**

Code "M" entered in the first position of the source code applies to items that are not procured but are capable of being fabricated or manufactured within the Marine Corps. These items have relatively low usage and will generally be fabricated or manufactured only as required for immediate repair or replacement. The code entered in the second position designates the lowest echelon authorized to manufacture or fabricate the item. Units will requisition the bulk material under the NSN's and the quantities indicated to effect the fabrication or manufacture of the item.

MO	Manufacture or fabricate at organizational maintenance level 2nd echelon.
MF	Manufacture or fabricate at intermediate maintenance level 3rd echelon.
MH	Manufacture or fabricate at intermediate maintenance level 4th echelon.
MD	Manufacture or fabricate at depot maintenance level 5th echelon.

SERIES P: PARTS PROCURED, SUPPLY SYSTEM STOCK

PA	Applied to items procured for the Marine Corps supply system for anticipated or known usage.
PB	Applied to items for which no usage is anticipated, but procured for the Marine Corps supply system in limited quantities for insurance purposes.
PC	Applied to items procured for the Marine Corps supply system which would be coded PA except that they are deteriorative in nature.

Figure 5-30. Definitions and Application of Source Maintenance Recoverability Codes (Sheet 2 of 6)

SOURCE CODES (Continued)

<u>Code</u>	<u>Application/Explanation</u>
PG	Applied to parts procured for Marine Corps supply system to provide for the sustained support for life of equipment. It is applied to an item peculiar to the equipment because probable discontinues or shutdown of production facilities would prove uneconomical to reproduce at a later time.

**SERIES X: NOT PROCURED, GENERALLY IMPRACTICABLE FOR STOCKING,
MAINTENANCE, OR MANUFACTURE**

Items listed, which are source coded XA or XB, may have been subsequently assigned to an NSN because of other applications in the Marine Corps. Therefore, if an item source coded in the XA or XB series is required, users are directed to first make the following investigations:

- a. Check the corresponding part number in the Master Cross-Reference List (C-RL), to determine if an NSN has been assigned.
- b. If an NSN has been obtained from the above check, refer to the Management Data List (MDL) for the latest supply management decision regarding the stock number.
- c. Check stock for availability of parts/parts having National Stock Number.
- d. If the review of stock discloses that the material is not available, refer to the MDL for inventory record data regarding the preferred NSN which may have been obtained in the Master Cross-Reference List (C-RL) and MDL review.
- e. Prepare a requisition citing the stock number shown in the MDL.

The above review will assist the user in obtaining the correct item of supply from the supply system, when available, rather than through the alternate methods such as salvage, requisitioning the next higher assembly, or

Figure 5-30. Definitions and Application of Source Maintenance
Recoverability Codes (Sheet 3 of 6)

SOURCE CODES (Continued)

<u>Code</u>	<u>Application/Explanation</u>
	recommending that the equipment be overhauled or retired. If a stock number for the desired item does not exist, then the source of supply as defined below will prevail:
XA	Applied to items not maintained in supply system; replacement of these parts is neither practical or economical. Support of end equipment will be effected by replacing the next higher assembly.
XB	Applied to items not procured for stock, but may be acquired for use through salvage. Activities requiring such items will attempt to obtain them from salvage; if not obtainable from salvage, such items will be requisitioned through normal supply channels citing manufacturer's code and part number with supporting justification.
XC	Applied to installation drawing, diagram, instruction sheet or field service drawing identified by a manufacturer's part number.

MAINTENANCE CODES

Maintenance codes are assigned to indicate levels of maintenance authorized to use and repair support items. The maintenance codes are entered in third and fourth position of the SMR code.

- a. Use (Third Position): The maintenance code entered in the third position will indicate the lowest maintenance level authorized to remove, replace, and use the support item. The maintenance code entered in the third position will indicate one of the following levels of maintenance:

Figure 5-30. Definitions and Application of Source Maintenance
Recoverability Codes (Sheet 4 of 6)

MAINTENANCE CODES (Continued)

<u>Code</u>	<u>Application/Explanation</u>
C	Crew 1st echelon
O	Organizational 2nd echelon
F	Intermediate 3rd echelon
H	Intermediate 4th echelon
D	Depot 5th echelon

- b. Repair (Fourth Position): The maintenance code entered in the fourth position indicates whether the item is to be repaired and identifies the lowest maintenance level with the capability to perform complete repair (i.e., all authorized maintenance functions).

O	Organizational 2nd echelon
F	Intermediate 3rd echelon
H	Intermediate 4th echelon
D	Depot 5th echelon
L	Repair restricted to designated Specialized Repair Activity.
Z	Non-repairable. No repair is authorized.
B	No repair is authorized. The item may be reconditioned by adjusting, lubricating, etc., at user level. No parts or special tools are procured for maintenance of this item.

RECOVERABILITY CODES

Recoverability codes are assigned to support items to indicate disposition action for unserviceable items. The recoverability code is entered in the Fifth Position of the SMR code.

Figure 5-30. Definitions and Application of Source Maintenance
Recoverability Codes (Sheet 5 of 6)

RECOVERABILITY CODES (Continued)

<u>Code</u>	<u>Application/Explanation</u>
Z	Nonrepairable item. When unserviceable, condemn and dispose at maintenance level indicated in position 3.
O	Repairable item. When uneconomically repairable, condemn at organizational level.
F	Repairable item. When uneconomically repairable, condemn and dispose at intermediate maintenance level 3rd echelon.
H	Repairable item. When uneconomically repairable, condemn and dispose at the intermediate maintenance level 4th echelon.
D	Repairable item. When beyond lower level of repair capability, return to depot. Condemnation and disposal not authorized below depot level.
L	Repairable item. Repair, condemnation, and disposal not authorized below depot/Specialized Repair Activity level.
A	Item requires special handling or condemnation procedures because of specific reasons (i.e., precious metal content, high dollar value, critical material or hazardous material). Refer to appropriate manuals/directives for specific instructions.

Figure 5-30. Definitions and Application of Source Maintenance
Recoverability Codes (Sheet 6 of 6)

<u>CODE</u>	<u>DEFINITION</u>
No code	Indicates that the part may or may not be authorized in initial allowances to using or supporting organizations.
D	Applied to maintenance parts that are not considered critical or essential to be on hand and are, therefore, not authorized in initial allowances; however, these items are stocked within the Supply System and may be requisitioned based upon usage.
T	Indicates that the part is authorized in garrison operating allowances in order to comply with state and local laws; however, the part is not authorized in Mount-Out since it is not combat essential.

Figure 5-31. Definitions of Special Stockage Indicator Codes

ITEM NO.	PART NO.	MFG CODE	ITEM NO.	PART NO.	MFG CODE
1	MIL-Y-40628	81349			
2	MS17830-8C	96906			
3	MS17830-10C	96906			
4	MS17830-12C	96906			
5	MS35307-414	96906			
6	MS35307-463	96906			
7	MS35307-489	96906			
8	MS87006-33	96906			
9	RRC271	81348			
10	13216E7992	97403			

Figure 5-32. Sample of Item Number Cross-Reference

STOCK NO.	ITEM NO.	MFG CODE	PART NO.
3940-00-168-6517	11	97403	13216E7993
3940-00-175-3591	12	97403	13216E7994
3940-00-175-7677	10	97403	13216E7992
4010-00-228-9933	9	81348	RRC271
4030-00-948-7315	8	96906	MS87006-33
5305-00-576-7188	7	96906	MS35307-489
5305-00-727-6804	5	96906	MS35307-414
5305-00-941-3579	6	96906	MS35307-463
5310-00-241-6609	4	96906	MS17830-12C
5310-00-406-7240	3	96906	MS17830-10C
5310-00-411-4385	2	96906	MS17830-8C
5340-00-849-7494	13	84256	BLDS8-19
8110-00-056-6243	1	81349	MIL-Y-40628

Figure 5-33. Sample of National Stock Number Cross-Reference

PART NO.	MFG CODE	ITEM NO.	STOCK NO.
BLDS8-19	84256	13	5340-00-849-7494
MIL-Y-40628	81349	1	8110-00-856-6243
MS17830-12C	96906	4	5310-00-241-6609
MS17830-10C	96906	3	5310-00-406-7240
MS17830-8C	96906	2	5310-00-411-4385
MS35307-414	96906	5	5305-00-727-6804
MS35307-463	96906	6	5305-00-941-3579
MS35307-489	96906	7	5305-00-576-7188
MS87006-33	96906	8	4030-00-948-7315
RRC271	81348	9	4010-00-228-9933
13216E7992	97403	10	3940-00-175-7677
13216E7993	97403	11	3940-00-168-6517
13216E7994	97403	12	3940-00-175-3591

Figure 5-34. Sample of Part Number Cross-Reference

INDEX		Paragraph, Figure, Table, Number
Subject		
A		
Accessory Section		8-24
Installation		4-54
Removal		T10-5
Actuating Pilot Valve Leakage Check		
Actuator, Compressor Bleed Valve		10-111
Assembly		10-108
Cleaning		10-107
Disassembly		10-109
Inspection		10-110
Repair		6-135
Adapter, Compressor Repair		
Afterburner		2-29
Description		8-110
Installation		F 9-8
Performance Limits		4-141
Removal		2-74
Air System		8-9
Airseal Installation		2-17
Anti-icing Air System Description		
B		
Baffle Assembly		6-28
Baffle and Spacer Inspection		6-29
Bearings, Anti-friction		6-15
Balance		6-16
Cleaning		F 6-11
Bleed Control Limit Curve		
Breather Pressurizing Valve		2-22
Disassembly		5-105
Installation		
C		
Carbon Seals		3-14
Cleaning		3-60
Inspection		
Combustion Chambers		3-128
Igniters		3-127
Inner Liners		3-126
Repair		
Compressor Bleed Valves		6-39
Check		6-7
Ground Safety Precautions		
		Index. 1

Figure 5-35. Sample of Index

PART VI. TECHNICAL CONTENT - TYPE IB. MANUALS
(Engineer, Ordnance and Motor Transport Equipment)

The following pages explain the technical content of Type IB. manuals covering the installation, operation, maintenance, and repair of engineer, ordnance, and motor transport equipment.

Arrange the technical contents of the manual as follows:

6-1. CHAPTER HEADINGS

- a. Chapter 1. General Instructions
- b. Chapter 2. Operating Instructions
- c. Chapter 3. Corrective Maintenance
- d. Chapter 4. Overhaul Instructions (4th or 5th Echelon).

Chapter 1. General Instructions

**6-2. CHAPTER 1.
GENERAL
INSTRUCTIONS**

Divide this chapter into three sections as follows:

- a. Section I. General Description and Specification Data
- b. Section II. Preparation for Use
- c. Section III. Demolition to Prevent Enemy Use.

Section I introduces and describes the subject equipment.
Include the following paragraphs:

**6-3. SECTION I.
GENERAL
DESCRIPTION
AND SPECIFIC-
TION DATA**

- a. Introduction. The first paragraph of Chapter 1 must cover scope, purpose, and leading particulars of the equipment. The scope must contain, but not be limited to, the following:

6-3.a. Introduction

"0-0. SCOPE. This manual covers the (echelons of maintenance) of the (official number and name of equipment as shown on cover) procured under Contract (number and date of contract) and includes Marine Corps Registration Numbers (insert numbers)."

The registration numbers will be provided by the Marine Corps for all equipment except Motor Transport. The registration numbers or serial numbers may be consecutive or broken as follows: 11247 through 11286 or 11247 through 11265 and 11287 through 11295. The purpose of the introduction is to acquaint the reader with the equipment and its intended use in as few words as possible. The use of photographs of the equipment, tables, and charts must be used extensively to portray this information.

**6-3.b. Description, Physical
and Functional**

- b. Description, Physical and Functional. These paragraphs must completely describe the equipment. The data will vary with the material and level of use intended, but all pertinent characteristic data must be included.

(1) **Physical Description.** Provide a physical description of the equipment or major units in tabular form. Physical properties such as dimension, weight, weather-proofing, shock and vibration characteristics must be described. Include disassembly and trouble isolation features (such as quick disconnect, and safety interlocks) and power and ventilation requirements. There are two basic requirements for photographs in this section. The first is the overall view calling out the

major components. In a complex weapons system an exploded view of major sections shall be used to provide a better understanding of the physical characteristics. The second requirement consists of interior and exterior views of all major sections, calling out major assemblies and subassemblies.

- (2) **Functional Description.** Provide a complete understanding of the equipment and describe the way in which the equipment achieves its objective. The functional description must be brief, factual, complete and must include items such as the following:

- (a) Intended use
- (b) Capabilities
- (c) Limitations
- (d) What it does
- (e) What it is used with
- (f) What it consists of
- (g) Function of each major unit.

Do not confuse the functional description with the theory of operation which is covered in paragraph 6-7.

- (3) **Reference Data Tables.** Reference data tables included in this section must provide technical characteristics such as principal dimensions, power requirements, spare requirements, and input-output data. Include tables for the following: equipment, tools, and publications supplied; equipment, tools, and publications required but not supplied (accessory items); and equipment similarities (between models).

(4) Difference in Models. Designation reference must be held to a minimum consistent with clarity. If the manual is to cover an item of equipment where there has been a series of changes that create minor model differences, describe briefly the major parts affected and state the serial number groups or model number changes which identify the various items. The following is a sample of the type of information that should be included in this paragraph.

"0-0. DIFFERENCE IN MODELS.

- a. Model GD-17 (figure 0-0) has a compression ratio of 6 to 1 and develops a continuous rating of 80 hp at 1120 rpm. It is equipped with a Zenith model 17 carburetor. No instruments or control extensions are furnished.
- b. Model GD-17A (figure 0-0) has a compression ratio of 7 to 1 and develops a continuous rating of 100 hp at 1280 rpm. It is equipped with two Stromberg model GT carburetors. Instruments and controls are grouped on a panel located above the flywheel."

**6-4. SECTION II.
PREPARATION FOR
USE**

Section II shall provide the necessary data to prepare the equipment for use. Include the following paragraphs:

6-4.a. Handling

- a. Handling. The handling of equipment is very important and should be completely covered in this section. Separate paragraphs must be included for unloading, uncrating, unpacking

and installation as necessary. Detailed illustrations of the handling procedures will be used in the manual only when the equipment is received specially packed or requires precision installation; otherwise, the text will cover the receipt of equipment in general.

- (1) Unloading Instructions. Include unloading instructions for all equipment. Instructions shall also be included for the operator of the vehicle. Explain and illustrate, if necessary, the removal of tie-down cables, strapping, or blocking and securing the equipment. Note any precautions necessary on removing the equipment from the truck bed, flatcar or other means of transport used.
- (2) Uncrating Instructions. Describe the proper procedure for uncrating to prevent damage to the contents of the container. If the equipment is packed in a reusable or sealed container, special precautionary instructions must be included to prevent damage to the container as well as to the equipment. A description of attaching hardware, listing and giving locations of the same, and procedural steps are sometimes required for complicated reusable containers.
- (3) Unpacking Instructions. Describe in general terms how equipment is packed. State the procedures to be followed in removing the equipment and accessories from their packaging. Include necessary precautions. Use phantom views or photographs of the packing case, showing the sides of the case partially removed to permit text reference to location of components and to packing of the equipment.

(4) **Installation Instructions.** If installation is required, describe and illustrate the procedure for installation or setup of the equipment. Include recommendations and precautions in the selection of operating sites. Provide diagrams showing staking and area required for a field unit. Include leveling precautions, procedures, and special instructions for equipment such as stone crushing plants and asphalt plants which can be set up to operate as single or multiple units. Provide reference to the base plan and shipping dimensions paragraph when applicable for judging size of equipment. The installation paragraphs must provide all information required for personnel to assemble and install the equipment. This installation procedure must be detailed and comprehensive, since it will serve both as training literature for installation and as an actual guide for personnel installing the equipment in the field. The procedures must be outlined step by step.

6-4.b. Servicing

b. **Servicing.** Provide a description of the service necessary before the equipment is to be put into operation. Detailed illustrations of the servicing procedures will be used only when there are special requirements. The normal phases of servicing the equipment in preparation for initial use must be covered in the text.

(1) **Removal of Protective Compounds.** Provide detailed instructions for the removal of corrosion preventive compounds, greases, etc.

(2) **Cleaning.** Provide instructions for cleaning the equipment. Specify type of cleaning for those components that contain electrical

wiring, such as brushing away dust and dirt, cleaning with compressed air, and cleaning with solvents.

- (3) Lubrication. Any special lubrication required prior to initial operation must be included in this paragraph. A reference to the lubrication instruction must be made for the normal lubrication requirements of a periodic nature.

- c. Initial Checkout and Adjustment. Include instructions for initial checkout, procedures, and values for adjustments to the equipment. Complete inspection of the equipment must be performed to insure that there are no loosened wires or bent pin contacts that they cause a short circuit when power is applied. After the initial checkout and adjustment instructions have been prepared, a reference should be made to the section on service requirements of the operator in the next chapter. The following is a sample of the type of information to be included in this paragraph:

**6-4.c. Initial Checkout
and Adjustment**

**"0-0. INITIAL CHECKOUT AND ADJUST-
MENT.**

- a. Make a complete visual inspection to see that required tools, repair parts, publications, accessories, and attachments are with equipment.
- b. Perform the before-operation services listed in paragraph 0-0.
- c. Visually inspect entire equipment for loss of parts or damage which may have occurred during loading, removal, or shipment.

- d. Check tires for proper inflation.
- e. Check cooling shroud over engine fly-wheel and make sure it has not been dented or otherwise damaged in shipment.
- f. Inspect housing, muffler, air cleaner, oil filter, and fan screen for visible damage. Remove engine side doors and inspect spark plug wires for firm connection.
- g. Check magneto, starter, and generator for loose connections and insecure mounting.
- h. Examine pump and pump connections for visible signs of damage. Inspect pump pressure gauge for damage or broken glass.
- i. Visually inspect all piping, lines, hose, wiring, and extensions for cracks or damage, loose connections, or missing parts. Make sure all drain plugs are securely tightened.
- j. Inspect tank, level gauge, and skirting for signs of damage.
- k. Lower and raise the fifth wheel to see if lift cable is secure and working. Spin the wheel to determine that drive cable and recorder are working.
- l. Inspect tail and marker lights for proper operation.
- m. Adjust fan and generator drive belt to proper tension. The belt has proper tension when it can be depressed approximately one-half inch by normal pressure (10 to 15 pounds).

- n. Turn on main power switch S-1.
 - o. Adjust R-24 until a reading of 120 volts is obtained on meter M-2.
 - p. Turn on low voltage switch S-2.
 - q. Place meter switch S-3 in the 250V position.
 - r. Adjust R-3 on the 250 volts power supply for a reading of $250 \pm$ volts on meter M-1.
 - s. Place meter switch S-3 in the +150 V, -150 V, +200 V, -200 V, and +500 V positions. Make sure meter M-1 reads the indicated voltage plus or minus two volts in each case."
- d. Relocation. Describe the procedures to be followed in transporting the equipment to a new site. Cover dismantling, packing, or securing for movement, storage of accessories or removed components, recommended transportation methods, and reinstallation. In the instructions, call for minimum disassembly so equipment can be made ready for operation in the shortest possible time. The following is a sample of the type of information to be included in this paragraph:

6-4.d. Relocation**"0-0. MOVEMENT TO NEW SITE.**

- a. Disconnect load from generator set.
- b. Drain fuel tank.
- c. The generator set is a self-contained unit and requires no disassembly for movement.
- d. The unit weighs 32 pounds and can be carried from one location to another.
- e. There are no particular requirements for site preparation for this equipment."

**6-4.e. Preparation for
Limited Storage and
Reshipment**

- e. Preparation for Limited Storage and Reshipment. Include instructions pertaining to the preparation of the material for reshipment and limited storage within scope of storage and using activities for the Zone of Interior. Detailed instructions and clear illustrations pertaining to domestic shipment, limited storage, loading and blocking on or in railroad cars, and necessary safety precautions to be observed for protection of the material will be included. Limited storage as defined in this section of the manual, must be from one day to two weeks. Short and long term storage are described in a later chapter.

**6-5. SECTION III.
DEMOLITION TO
PREVENT ENEMY USE**

Section III provides instructions for destroying equipment to prevent enemy use. Include the following paragraphs:

6-5.a. General

- a. General. Cover methods of destroying material when in danger of imminent capture, in order to prevent enemy use. Several methods will be presented, all making use of tools, equipment, or explosives which normally will be available to the user of the material. The following paragraph is a standard paragraph and must be included in all technical manuals on equipment.

"0-0. GENERAL. When capture or abandonment of the (insert name of equipment) to any enemy is imminent, the responsible unit commander must make the decision to either destroy the equipment or to render it inoperative. Based on this decision, orders are issued which cover the desired extent of destruction."

- b. Demolition to Render the Equipment Inoperative. Include demolition by misuse and by mechanical means, using sledge hammers, picks, axes, or any other tools which may be available. The following is a sample paragraph:

**6-5.b. Demolition to
Render the Equip-
ment Inoperative**

**"0-0. DEMOLITION TO RENDER THE
(INSERT ITEM NAME) INOPERATIVE.**

- a. Demolition by Mechanical Means. Use hammers, crowbars, picks, or other tools which may be available to destroy the engine block, manifold, carburetor, magneto, governor, and water pump.
- b. Demolition by Misuse. Perform the following steps to render the (insert item name) inoperative.

- (1) Drain radiator and crankcase. Place sand, nuts, bolts, or broken glass into radiator opening, oil filter tube and fuel tank.
- (2) Disconnect radiator fan and run engine full throttle."

- c. Demolition by Explosives or Weapons Fire. Provide necessary instructions for demolition by explosives or weapons fire.

**6-5.c. Demolition by
Explosives or
Weapons Fire**

- (1) Provide an outline illustration of equipment showing placement and size of demolition charges. Charges will be indicated on the illustration by nomenclature callouts. Refer to FM 5-25, Explosives and Demolition.

(2) Normally, small items of equipment which do not weigh more than 150 pounds can be demolished without use of explosives or weapons fire. Therefore, instructions for explosives or weapons fire demolition will not be included for this type of equipment.

(3) Priority for destruction of various components of equipment, in event the completed action cannot be taken in time available, should be indicated.

6-5.d. Other Demolition Methods

d. Other Demolition Methods. Include methods such as scattering and concealing of parts, burning, and submersion of equipment.

**6-6. CHAPTER 2.
OPERATING
INSTRUCTIONS**

Chapter 2. Operating Instructions

Divide this chapter into five sections as follows:

- a. Section I. Theory of Operation
- b. Section II. Service Requirements of Operator
- c. Section III. Controls and Instruments
- d. Section IV. Operation Under Specific Conditions
- e. Section V. Operation of Equipment Used In Conjunction with Major Item.

**6-7. SECTION I. THEORY
OF OPERATION**

This section contains the following paragraphs:

6-7.a. General

- a. General. This section must contain a detailed description and discussion of the mechanical functioning and electrical theory of operation of the entire equipment. Electrical circuit theory covered in basic electrical and mechanical courses must not be repeated in the manual.

Nonstandard circuits or new circuit arrangements, new types of vacuum tubes or special types of vacuum tubes not widely employed, special methods or complicated mechanical features must be clearly explained using photographs and text.

- b. Electrical and Electronic Theory. Discuss the theory of operation of electrical and electronic components in terms comprehensible to personnel within the organization qualified to maintain it. Semiconductor devices will require more detailed information than vacuum tubes.

**6-7.b. Electrical and
Electronic Theory**

- (1) Block diagrams must be used to supplement the text covering theory of operation of the entire equipment. Where equipment's nature, relative complexity, and number of components make it practicable, prepare individual schematic diagrams to cover signal circuits, power circuits, and control circuits.
- (2) Label incomplete circuits (or diagrams) to tie in with other connecting unit diagrams. Layout the schematic diagram in true functional manner (sacrificing similarity of actual mechanical layout if necessary), in order to enable technicians to proceed rapidly and efficiently. Separate the halves of twin tubes and locate each half at the appropriate place in the circuit. Draw similar circuits in a similar manner. Draw main signal paths heavy with arrows to indicate flow when necessary. Use arrows on other lines also to indicate flow. Utilize block diagrams and schematics wherever feasible.

- (3) When applicable, locate the waveform and magnitude of the voltage at significant points in the circuit on simplified schematic and block diagrams as determined by allocation of tools, testing equipment, etc. For example, if an oscilloscope is authorized, the technician will be required to know the correct waveform and magnitudes of voltages at certain points. Type of scope and settings must be provided. Identify phase relationships where important. These waveforms should be given on both functional diagrams and on complete diagrams. On simplified schematics with switches or other circuit complications, a simple line diagram of each contributing circuit necessary to understand organizational maintenance must be included.
- (4) A schematic diagram of a component should show symbolic imaginary lines enclosing parts such as IF transformers, gang-tuned condensers, controls, etc. For each circuit part, insert principal characteristics expressed in actual values (ohms, microfarads, etc). Tabulate electrical values on the illustration indexed by reference designator to applicable points on diagram when sufficient space is not available on the diagram itself. Express values in numbers, omitting unit of measurement (such as ohms, except in designating those units in which both inductance and resistance values are stated) provided an appropriate note is made a part of the diagram. For example, "all values are expressed in microfarads, microhenries and ohms unless otherwise indicated." However,

the meaning should be unmistakable. Symbolic imaginary lines must include all components comprising an individual major unit. Provide practical wiring, terminal voltage, terminal resistance and interconnecting cable diagrams as necessary.

- c. Mechanical Theory. Discuss only essential theory involved. Elementary mechanical construction must not be discussed (such as theory of operation for a gasoline or a diesel engine or a generator set). In discussing mechanical arrangements such as a geared power train, the first-to-last order is more appropriate; however, in describing a gun turret, use whole-to-part order.

Note that the operation or maintenance personnel must know the theory of operation well enough to be able to intelligently troubleshoot the equipment. To illustrate this section, use isometric orthographic schematics.

This section contains the following paragraphs:

- a. Service Upon Receipt of Equipment. The purpose of this section is to instruct the operator in duties upon receipt of the equipment. Only those duties which are to be performed by the operator must be included in this paragraph (such as checking fuel, oil, and water levels in a vehicle or checking for loose connections, tubes, and fuses in electronic equipment).

6-7.c. Mechanical Theory

**6-8. SECTION II.
SERVICE
REQUIREMENTS
OF OPERATOR**

**6-8.a. Service Upon
Receipt of
Equipment**

- (1) Inspection. Provide a list of items and areas to be inspected to ensure that no damage to equipment has occurred since the inspection required when equipment was initially prepared for use. (Refer to paragraph 6-4.b.)
- (2) Lubrication. Reference shall be made here to the lubrication instruction (see Specification MIL-L-22690).
- (3) Completeness of Equipment. Refer to the tables which lists equipment and publications required to operate the equipment. Inspect for completeness; ensure all equipment is there.

6-8.b. Preventive Maintenance Services (PMS)

- b. Preventive Maintenance Services (PMS). The purpose of this paragraph is to instruct the operator in duties of service requirements before, during, and after operation. These preventive maintenance instructions shall be in the form of a preventive maintenance service chart to include task descriptions and schedule of service. (See figure 6-1 as an example of the type of information to be included.) The procedures shall be written clearly to ensure that the equipment is ready for operation at all times.

**6-9. SECTION III.
CONTROLS AND
INSTRUMENTS**

This section provides the following information:

6-9.a. Location of Controls and Instruments

- a. Location of Controls and Instruments. Include a statement similar to the following in this section.

"0-0. GENERAL. This section describes, locates, illustrates, and furnishes the operator, crew, or organizational maintenance personnel

sufficient information pertaining to the various controls and instruments provided for the proper operation of (insert short nomenclature of equipment)."

- b. Function of Controls and Instruments. In addition to the above general paragraph, the following information must be included.

**6-9.b. Function of
Controls
and Instruments**

- (1) Give location, description, and purpose of each control or instrument.
- (2) Identify controls and instruments in the text exactly as they are marked on the equipment, except that reference must be all upper case. If equipment marking is abbreviated, an explanation of its true meaning must be given.
- (3) Describe only what the control or instrument is used for and not how to use it or how it is used. Use charts, diagrams, or illustrations to show these details.
- (4) Similarly treat each instrument, describing the minimum, normal, and maximum readings for normal operation of the equipment. Include a brief statement of irregular readings to be observed, and the precautions to be taken when they occur. Use tabulated readings where practicable.
- (5) Normally devote a separately numbered paragraph to each control and instrument.
- (6) Use illustrations of groups of instruments and controls such as control panels to locate and identify more important instruments.
- (7) Do not provide coverage on simple controls such as draincocks, when not essential for operation of the equipment and adequate

coverage is provided elsewhere in the manuscript.

- (8) If there are numerous controls and instruments, as in gas-generating equipment or a missile control panel, a more logical arrangement is to devote a separate paragraph to each category (like valves and pressure indicators) and list all controls or instruments in each category in a table. Haphazard operation or improper setting of controls can cause damage to equipment; it is important to know the function of every control. Sample paragraphs of this type of information are as follows:

"0-0. START AND STOP SWITCHES. The START switch (12, figure 0-0), and the STOP switch (13) are conventional pushbutton-type switches. They are located on the right hand corner of the control panel frame (21). The START switch closes the circuit between the battery and the starting solenoid. The STOP switch grounds the primary circuit of the magneto.

0-0. GOVERNOR CONTROL ASSEMBLY. The governor control assembly (14, figure 0-0), is a wire sleeve-type control with a T-shaped handle, and is attached to the throttle lever on the governor. It is located on the right section of the control panel frame. The control places the engine in idling speed or governed operating speed.

0-0. OIL PRESSURE GAUGE. The oil pressure gauge (16, figure 0-0), is a dial gauge calibrated in psi from 0 to 75. It is located on

the center section of the control panel frame.
The oil pressure gauge measures the oil pressure within the engine lubricating system and is red-lined at 20 and 55 psi."

- c. Precautions To Be Observed By The Operator.
Warnings and cautions must be placed just before a description of a control or instrument where the incorrect operation could cause damage to the equipment or endanger the personnel.

This section may be treated as indicated below or may be combined into one paragraph depending upon the complexity of the equipment and the type of operating condition it will encounter. For test equipment, the step-by-step detailed test procedures to use the equipment must be included.

- a. Operation Under Normal Conditions.

- (1) Include instructions for the operator of the equipment under moderate climatic and normal operating conditions. The instructions must be in the form of step-by-step procedure with the aid of picture-guide techniques to supplement the text as shown in figure 6-2.
The following is an example:

"0-0. OPERATING THE SECONDARY DRUM CLUTCH LEVER. Operate the secondary drum clutch lever using the sequence of steps shown in figure 6-2."

- 6-9.c. Precautions To Be Observed By The Operator**

- 6-10. SECTION IV.
OPERATION
UNDER
SPECIFIC
CONDITIONS**

- 6-10.a. Operation Under Normal Conditions**

(2) Restrict the explanation and instruction in the section to what the operator must do, how it must be done, and when he must do it. It must be assumed that the equipment has been properly adjusted after installation and is free from all maintenance problems. Equipment that is very complex and part of a system may require the expansion of this section into several sections; if not, all the necessary instructions are given below. Include an introductory paragraph.

**6-10.b. Operation Under
Emergency Conditions**

b. Operation Under Emergency Conditions. This paragraph must supplement the above information when equipment is to be operated during emergency conditions. Operating an engine at high rpm for short periods of time, operating a radio set during atmospheric disturbances or jamming and during partial failure are examples of emergency operation.

**6-10.c. Operation Under
Unusual Conditions**

c. Operation Under Unusual Conditions. Include special operating instructions, in addition to those previously covered, which are necessary for the proper functioning of equipment under unusual conditions such as, extreme cold or heat, high humidity, sand, snow, mud, salt-water areas, high altitudes, or similar conditions not normally encountered. Include lubrication and scheduled maintenance service for operation under unusual conditions in lubrication and scheduled maintenance sections of the manual. Provide paragraphs indicating that operation of equipment in arctic, desert, or tropical regions may be quite

different from its operation in a temperate climate. Paragraphs will be prepared to cover each condition.

This section must contain a detailed description and instruction on the operation of auxiliary equipment, only when pertinent items are not covered by other available technical publications as listed in paragraph 1-4. Use of the picture-guide technique is encouraged. Equipment such as cold starting aids, heaters, fire extinguishers, hoists, winches, and engine heaters which are supplied for use with the basic major item must be covered, unless waived by the Contracting Officer. If auxiliary equipment has a separate manual, make reference to that manual and list it in the applicable appendix. The following are samples of the type of paragraphs to be included in this section.

**6-11. SECTION V.
OPERATION OF
EQUIPMENT USED
IN CONJUNCTION
WITH MAJOR
ITEM**

"0-0. FIRE EXTINGUISHER. (Carbon Dioxide Type).

- a. Description. The carbon dioxide type fire extinguisher is suitable for use on electrical and flammable liquid fires. Carbon dioxide types are of the 4-pound, 7-½ pound, and 10-pound sizes.
- b. Operation. Remove fire extinguisher from its location, break seal, operate control valve, and direct stream of contents at base of flame.
- c. Refilling and Maintenance. For detailed instructions on refilling and maintenance, refer to applicable technical manuals on fire extinguishers."

"0-0. COMMUNICATION SYSTEM.

- a. Description. The radio set AN/TRC-25 is a two-way battery operated set. The set provides voice or MCW communications on any one of six preset channels in the 225-390MC frequency range.
- b. Operation. Choose an elevated antenna location wherever possible. Select proper channel of operation by means of the CHANNEL selector. Turn set on and wait approximately one minute for set to warm up.
- c. Maintenance of Set. For detailed maintenance of set, refer to applicable technical manuals on equipment."

"0-0. WINCH.

- a. Description. The winch is attached to the front frame of the vehicle. It is connected to the engine of the vehicle through a gear train and clutch.
- b. Operation. The winch is operated from the cab of vehicle using a special clutch and gear box with a separate lever.
- c. Maintenance. For maintenance, the winch shall be removed from frame of vehicle.

(1) Removal of winch. A hoist or chain block capable of handling 3000 pounds must be available. Use of a standard sling will be required.

- (2) Removal of cable from winch.
Unwind the cable etc."

Chapter 3. Corrective Maintenance

This chapter contains the following sections:

- a. Section I. Introduction
- b. Section II. Tools and Equipment
- c. Section III. Troubleshooting
- d. Section IV. Corrective Maintenance
- e. Section V. Care and Preparation for Storage.

Explain the purpose, scope, and arrangement of the corrective maintenance data.

This section contains the following paragraphs:

- a. General. This section applies to all echelons of maintenance. Coverage within this section will be governed by the complexity of the end item.
- b. Tools and Material Carried With the Equipment. Tools, equipment, and repair parts are issued to operator, crew, or user for operating and maintaining equipment. Briefly locate and describe storage boxes and compartments, brackets, ammunition racks, and the like. List electronic test equipment by JAN nomenclature. List other items by Cataloging Handbook H6-1 nomenclature.
- c. Special Tools and Equipment. For different echelons of maintenance there will be a different complement of special tools, equipment, and repair

6-12. CHAPTER 3. CORRECTIVE MAINTENANCE

6-13. SECTION I. INTRODUCTION

6-14. SECTION II. TOOLS AND EQUIPMENT

6-14.a. General

6-14.b. Tools and Material Carried With the Equipment

6-14.c. Special Tools and Equipment

parts. For example, if the procuring agency divides levels of maintenance (requires more than one maintenance level), in the -15 manual, a table would be the best method of indicating these tools with the echelons of maintenance. In the -10 through -50 and -12, -34, -35, and -45, these special tools and equipment must be an integral part of the specific maintenance chapter or section. Provide illustrations showing use of any of the special tools used in a special way for adjustment or calibration at the point where instruction is given.

**6-14.d. Fabricated
Tools and
Equipment**

- d. Fabricated Tools and Equipment. The following example paragraph will be used in the manuscript when it applies to the item of equipment. If no fabricated tools or equipment are required, note this fact in paragraph 6-14.c. Eliminate this paragraph from the manual.

(1) The following is a sample of the type of information required.

"0-0. FABRICATED TOOLS AND EQUIPMENT. Fabricated tools and equipment are for use of depot maintenance personnel performing major overhaul work on the (insert short name of item). Tools and equipment listed for use are not available for issue, but must be fabricated by qualified depot maintenance personnel."

(2) **Description and Details.** Describe and give details such as material dimensions, thread sizes, and so forth. In event only one item of fabricated tools or equipment is required, the

information may be presented by an illustration and detailed test. The illustration must be a line drawing indicating all pertinent dimensions. In event more than one item of fabricated tools or equipment are required, the information must be presented by an illustration plus a table which lists the items by more figure and paragraph references with brief description of their uses.

Troubleshooting is the accurate reporting of symptoms so maintenance personnel responsible for equipment can diagnose, isolate, and correct the trouble with the least possible delay. This section contains all instructions and information necessary to locate equipment malfunctions and to conduct tests on each component, assembly, or subassembly of the equipment. This section applies to all echelons of maintenance. Coverage within this section will be governed by complexity of end item. This section contains the following paragraphs:

- a. Introduction. The introduction shall explain the approach and logic of the troubleshooting procedures presented in the manual. Describe the troubleshooting data and show how they relate to one another.
- b. Troubleshooting Procedures. Troubleshooting procedures must include all information required for trouble isolation and references to applicable section and paragraph for repair of the equipment. See figure 6-3 as a sample of the information required.

6-15. SECTION III. TROUBLE- SHOOTING

6-15.a. Introduction

6-15.b. Troubleshooting Procedures

**6-16. SECTION IV.
CORRECTIVE
MAINTENANCE**

This section shall contain instructions required to adjust and align the equipment, remove, repair, reinstall, and align all repairable parts, modules, subassemblies, and assemblies. The instructions shall identify the action to be accomplished, safety precautions to be observed; tools, parts, materials, and test equipment required; preliminary control settings, test equipment setup instructions; and step-by-step instructions, with supporting illustrations, to accomplish the maintenance task. Corrective maintenance instructions shall be provided for all items designated repairable irrespective of the maintenance concept unless this information is included in another technical manual and can be referenced.

6-16.a. Introduction

a. Introduction. Explain the purpose, scope, and arrangement of the corrective maintenance data. Maintenance instructions must be specific; observe the following:

- (1) State exactly what steps should be taken, and in what order. Use a numbered list of steps, one step at a time. Include a complete checkout for complex equipment or systems. List minimum standards that must be maintained by the item of equipment such as "the voltage shall not drop below 25 volts."
- (2) Completely identify and illustrate special tools, rigging, or other accessory equipment mentioned. Include their exact names, their location if pertinent, and their identifying number, if any.
- (3) In lubrication instructions, begin with a general statement explaining that overall lubrication must be in accordance with the applicable Lubrication Instructions. Amplify

critical items and give reasons for special precautions such as a CAUTION about excessive lubrication.

- (4) In adjustment instructions, begin with a general statement explaining conditions that make adjustment necessary. Describe the critical positions of the parts to be adjusted, and their relationship to others which may have been misaligned during a later adjustment of another part. List and number detailed steps of adjustment, one step at a time, showing particular items in a figure as required.

Example:

"0-0. ADJUSTMENT. The clutch drive spring on clutch shipper shaft must be adjusted to provide sufficient force to engage clutch fully.

Safety device must be open when selector lever is at HAND position.

- a. Set loader (16) at ZERO position, with clutch (18) disengaged.
- b. Loosen lockwasher (21) and locknut (22) at adjusting nut (23).
- c. Turn adjusting nut (23) until end of the bolt (20) is 1/4 inch from the face plate (24).
- d. Reset locknut (22) and lockwasher (21).
- e. Check adjustment etc."

- (5) In trouble-analysis instructions, include evidence or symptoms of failure, probable causes of failure, beginning with the simplest or most likely to occur, and remedies for each cause, again beginning with the most likely.

- (6) Give removal instructions first, then installation instructions. Installation instructions must be complete and detailed. The phrase "Install in reverse order of removal" must not be used.

**6-16.b. Adjustments
and Alignment**

- b. Adjustments and Alignment. Include all information and procedures required to perform all necessary adjustments and alignments as follows:
 - (1) Non-operator type adjustments
 - (2) Alignments requiring external jigs, test equipment, or bench setups
 - (3) Alignments that are accomplished after a repair or replacement of a part or module
 - (4) Test equipment setup and other illustrations necessary to support the procedures.

6-16.c. Repair

- c. Repair. All procedures required in the repair of assemblies and repairable parts shall be identified. Repair procedures shall include but not be limited to the following:
 - (1) Removal, disassembly, and inspection
 - (2) Repair or replacement of piece parts
 - (3) Cleaning, reassembly, adjustment, installation, calibration, and checkout
 - (4) Exploded views, sectional views, wiring diagrams, and photographs necessary to support the procedures
 - (5) Obvious repair actions such as soldering, use of multimeters, hand tools, etc. shall not be included except where these actions involve hazards to personnel or equipment.
 - (6) Repair procedures shall be arranged in numeric-alpha unit designation order of the equipment.

d. Supporting Illustrations and Data. The use of clear, sharp illustrations to supplement description and maintenance coverage is required. Exploded views are required for parts location illustration. As a minimum, illustrations or sketches of the following shall, when applicable, be included:

- (1) Typical bearings for rotating or moving equipment
- (2) Method of taking clearance measurements where required
- (3) Typical mechanism for absorbing thrust where applicable
- (4) Locking devices when applicable
- (5) Typical seal assembly (pressure and/or vacuum seals or controlled leakage between rotor and casing)
- (6) Typical assembly of blading to rotor, with lock devices, where applicable
- (7) Typical assembly of field poles, laminated core iron, electrical windings, commutator, slip rings, and brush rigging where applicable
- (8) Equipment assembly with upper casing partially removed
- (9) Series of illustrations showing installation of supervisory instruments.

This section contains the following paragraphs:

a. General. This section must be included in all manuals covering intermediate maintenance or higher. Include necessary instructions for

6-16.d. Supporting Illustrations and Data

6-17. SECTION V. CARE AND PREPARATION FOR STORAGE

6-17.a. General

preparing the equipment for storage so that it will be adequately protected under prevailing climatic conditions. Instructions must include the special required technical inspection, cleaning, preservation, lubrication, weatherproofing, and any other special service necessary to prepare the equipment for storage. This storage must not exceed three months.

6-17.b. Long Term Storage

- b. Long Term Storage. The paragraph on long term storage must be similar to the previous paragraph with the exception that the processing, packaging, and packing will be much more extensive.

NOTE: Close coordination with the contracting office must be maintained in preparation of Section V, since different equipments in different areas of the world require special treatments in care and preparation for storage.

**6-18. CHAPTER 4.
OVERHAUL
INSTRUCTIONS**

Chapter 4. Overhaul Instructions

This chapter contains the following sections:

- a. Section I. General
- b. Section II. Tools and Equipment
- c. Section III. Inspection
- d. Section IV. Overhaul Procedures.

**6-19. SECTION I.
GENERAL**

This section contains the following paragraphs:

6-19.a. Definition and Scope

- a. Definition and Scope.

- (1) Definition. Depot (5th Echelon) maintenance is the repair embracing major overhaul or complete rebuild of parts, subassemblies, assemblies, or the end item. This is

accomplished using the common sense approach of IROAN (Inspect and Repair Only as Necessary). It normally supports the supply function by rebuilding and returning to stock on a scheduled basis.

- (2) **Scope.** This paragraph must present scope of instructions included in this chapter. Instructions provided in this chapter will assist depot maintenance personnel in complete overhaul (Rebuild) of equipment. The following standard paragraph must be included in the manual:

"0-0. SCOPE. The following instructions are provided for the use of depot maintenance personnel. They contain information on the maintenance of (insert short name of item) which is beyond the scope of tools, equipment, personnel, or supplies normally available to lower echelon maintenance facilities."

- b. **Description and Data.** To avoid repeating the general description of equipment, refer to applicable paragraphs contained in the organizational maintenance portion of manual. If subject publication is to be a -35, -45, or -50 portion in a multiple-unit manual, refer to -10 (operator's) manual for this information.

**6-19.b. Description
and Data**

- (1) **Instruction.** Include all data on the equipment, its accessories, and auxiliaries which are pertinent to depot maintenance facilities covered in subject publication and not included in other parts of the manual. This will include:

- (a) Classification and rating information of main components and auxiliaries.

- (b) Repair and Replacement Standards for ready reference on all assemblies.
- (c) Installation clearances with maximum allowable clearance, adjustment, and alignment clearances, and similar data.
- (d) Charts showing Time Standards for higher echelon work on equipment, such as time required to remove and replace major assemblies, minor assemblies, major and minor parts, common hardware, and all procedures required in repair and rebuilding of equipment.
- (e) All data mentioned in the text of the particular part of the manual will be tabulated.

(2) See figure 6-4 as a sample of the type of information to be included in this paragraph.

6-20. SECTION II. TOOLS AND EQUIPMENT

This section contains the following paragraphs:

6-20.a. General

- a. General. Tools and equipment over and above those available to lower echelons of maintenance are supplied to depot for equipment overhaul. Standard and commonly used tools and equipment are authorized for issue by tables of allowances and tables of equipment and need not be covered here.

6-20.b. Special Tools and Equipment

- b. Special Tools and Equipment.

(1) Definitions. Special tools are those tools issued and designed for a specific function on one type of equipment. In this chapter, special tools are those tools required or

desired to perform fifth echelon maintenance for which no requirement exists at a lower echelon.

- (2) The following is a sample of the type of information required in this paragraph.

"0-0. SPECIAL TOOLS AND EQUIPMENT.

Special tools and equipment required to perform repair and overhaul operations on the (insert short name of item) and accessories are listed in Table 0-0. (See figure 6-5 as an example.) Reference and illustrations indicating the use of these tools are listed in the table."

- (3) Instruction. Describe the special tools and equipment required to perform repair operations identified in the manual. Describe their use and provide any other information such as referenced or specific instructions for their use. If no special tools are required, note this fact in the paragraph. If special tools or equipment are required for performing the maintenance function, prepare a table as shown in figure 6-5. In the column designated "Stock Number", provide the National Stock Number (NSN) for all tools and equipment listed.

- c. Fabricated Tools and Equipment. The following example paragraph will be used in the text when it applies to the item of equipment. If no fabricated tools or equipment are required, note this fact in paragraphs 6-20.b. Eliminate this paragraph from the manual.

**6-20.c. Fabricated
Tools and
Equipment**

- (1) The following is a sample of the type of information required.

"0-0. FABRICATED TOOLS AND EQUIPMENT. Fabricated tools and equipment are for use of depot maintenance personnel performing major overhaul work on the (insert short name of item). Tools and equipment listed for use are not available for issue, but must be fabricated by qualified depot maintenance personnel."

- (2) Description and Details. Describe and give details such as material dimensions, thread sizes, and so forth. In event only one item of fabricated tools or equipment is required, the information may be presented by an illustration and detailed test. See figure 6-6 as an example. The illustration must be a line drawing indicating all pertinent dimensions. In event more than one item of fabricated tools or equipment are required, the information must be presented by an illustration plus a table which lists the items by more figure and paragraph references with brief description of their uses.

6-21. SECTION III. INSPECTION

This section contains the following paragraphs:

6-21.a. Purpose

- a. Purpose. Present the purpose for which inspections of equipment are included in overhaul procedures. Explain the need for determining serviceable or unserviceable condition of component or recognizing conditions which

indicate early failure of a component or its damaging other components.

- b. Scope. Briefly describe the extent of technical inspections to be performed by depot maintenance personnel. Define pre-overhaul inspection, in-process inspection to be performed during overhaul, and final inspection after overhaul has been completed.

6-21.b. Scope

- c. Categories of Inspection.

6-21.c. Categories of Inspection

- (1) Pre-Overhaul. This inspection is made upon receipt of an item at a depot for overhaul and prior to start of overhaul procedures. It is designed to establish the initial requirement parts, to schedule equipment items introduced into the shop workload, and to estimate the extent of overhaul required. Reference must be made in these instructions to "Time Standards", in order to establish the total man hours required to accomplish the procedures indicated in pre-overhaul inspection.
- (2) In-Process. In-process inspection is the quality control inspection of performance and minimum acceptance standards throughout. This inspection is a continuing process during overhaul of the equipment. It is designed to ensure that all replacement parts conform to prescribed standards and that workmanship is in accordance with approved methods and procedures. Reference must be made in these instructions to the data and standards presented in paragraph 6-19.b.

- (3) Final. Final inspection is that minimum performance acceptance inspection gained by final test of an end item. This inspection is made upon completion of overhaul procedures. It is performed by experienced personnel to ensure that equipment is acceptable in accordance with the performance data presented in paragraph 6-19.b.

**6-22. SECTION IV.
OVERHAUL
PROCEDURES**

Procedures must be sequenced to be logical and exact. Procedures must be fully illustrated. (See figure 6-7 for a sample of a picture guide technique.) Support each technique and procedure outlined in the text by illustrations depicting removal points, disassembly techniques, components, and areas of components requiring cleaning and inspection, measurement procedures for the determination of wear, repair techniques, reassembly and installation points, and test devices and their operation. Instructions for reassembly and installation must be complete and detailed. The phrase "Reassemble and install in reverse order of removal and disassembly" must not be used. The following format must be employed to present instructions required by succeeding paragraphs of this Style Guide:

- 0-0. (Item name) Removal and Disassembly
- 0-0. (Item name) Cleaning and Inspection
- 0-0. (Item name) Repair and Replacement
- 0-0. (Item name) Lubrication
- 0-0. (Item name) Reassembly and Installation
- 0-0. (Item name) Test and Operation.

This sequence (as applicable) must be repeated for each component of the end item. Utilize only pertinent items. For example, disassembly will not be used for those items

maintained by complete component replacement (fan belts, thermostats, condensers, vacuum tubes, and the like), and lubrication will be used only on components requiring it. Repeat instruction for each component or assembly subject to overhaul procedures.

a. Removal and Disassembly.

**6-22.a. Removal and
Disassembly**

- (1) Removal. Present detailed, illustrated instructions for step-by-step procedures required to remove subject component from end item. Include instructions to tag critical parts requiring special handling and to scribe matching surfaces in cases where it is possible to improperly install a component during installation. Do not repeat instructions for any removal procedures presented in previous chapters of the manual but incorporate those procedures here by reference to applicable preceding text. Care should be exercised in covering requirements in this paragraph for special or fabricated tools.
- (2) Disassembly. Present detailed, illustrated instructions for step-by-step procedures required to completely disassemble the subject component. Include instructions to tag critical parts requiring special handling, to scribe matching surfaces in cases where it is possible to improperly install a part during reassembly, and to use containers to store very small parts which could be misplaced or lost. Care should be exercised in covering requirements in this paragraph for special or fabricated tools.

6-22.b. Cleaning and Inspection**b. Cleaning and Inspection.**

- (1) **Cleaning.** Present instructions for proper cleaning procedures using approved cleaning agents. Procedures and agents will differ widely in manuals covering different types of equipment. For example, steam cleaning and vapor baths will be employed in cleaning machinery and heavy machinery parts, while the same methods would be damaging to items having fabric, leather, rubber, or those compositions usually incorporated in electrical and electronic devices. Recommend an individual type of cleaning agent for each type or composition of components. The contractor is responsible to research the appropriate Federal and Military documents in order to accurately specify the approved cleaning agent for the specific application. The phrase "using an approved solvent" is not definitive to a degree desirable or even useful in a military manual, since the manual must be used frequently in situations and locations where time to research and source material with which to research the "approved solvent" for a specific application are non-existent. In addition to prescribing the proper cleaning agent, this paragraph must contain detailed, illustrated instructions for any required cleaning methods which are of a unique nature. Normal cleaning procedures need not be illustrated.
- (2) **Inspection.** Prescribe inspection to be accomplished. Include references to tolerance and wear limit data contained in paragraph 6-19.b.

and performance standards. Illustrate use of special or fabricated tools, if any, and cover in detail use of precision instruments such as meters, scopes, signal generators, and mechanical measuring devices.

- c. Repair and Replacement. Include instructions for repair of those components which can be repaired by depot maintenance personnel. Describe repair techniques and illustrate difficult or complex techniques such as electronic printed circuits. Common shop procedures such as commutator undercutting, thread chasing, radiator brazing and leak testing, and the like need not be illustrated but should be adequately covered by text. Repair and replacement standards presented in paragraph 6-19.b. should be freely referenced in this paragraph. Cover in detail any replacement technique of a difficult or complex nature. In simple, unit component replacement, merely state "Replace the (unit component) with a like, serviceable item". This paragraph should be closely associated with paragraph 6-22.b.(2), and should cover all items mentioned in that paragraph.

- d. Lubrication. Those lubrication procedures involved in equipment rebuild must be covered. Complete lubrication, in accordance with lubrication instruction for the specific item of equipment, must be accomplished after reassembly and before operation. Those components requiring lubrication of mating surfaces and which have been cleaned prior to inspection should be lubricated before reassembly. Ball or roller-type bearings should be repacked at this time and all shafts, sleeves, and other components which operate in

**6-22.c. Repair and
Replacement**

6-22.d. Lubrication

close tolerance with other surfaces should be coated with a film of proper lubricant.

6-22.e. Reassembly

- e. Reassembly. In almost every instance, reassembly of components involves nothing more nor less than an exact reversal of disassembly procedures, however, the procedures must be reiterated. Illustrations used to explain disassembly procedures should be referred to in presenting reassembly instructions. Where jigs, fixtures, presses, and the like are required in reassembling assemblies and subassemblies, their use should be illustrated to the extent required for clarity of instruction. Carefully call attention to those items which have been tagged during disassembly for special handling, as well as those items whose matching surfaces have been scribed for guidance in proper positioning during reassembly. Nut and bolt torque data (presented in paragraph 6-19,b.) should be freely referenced here, as should clearance, adjustment, and alignment data in that paragraph.

6-22.f. Installation

- f. Installation. Installation procedures must be presented here for all components treated in removal instructions (see paragraph 6-22.a.(1)). Sequence of instructions in this paragraph is very important, and care must be taken that instructions are not contradictory to or inconsistent with any other instructions throughout the manual. Items which were tagged during removal for special handling, and items whose matching surfaces were scribed before removal to prevent improper positioning during installation must be covered by appropriate instructions in this paragraph. All pertinent data

in paragraph 6-19.b. should be incorporated by reference in these instructions.

g. Operation and Test.

**6-22.g. Operation and
Test**

- (1) Operation. Present instructions for operation of entire item after overhaul and include precautions concerning readings of all instruments and meters and operation of all controls. Advise on specific indications of deficiencies to observe, such as strange noises, evidence of improper voltages, currents, pressures, temperatures, binding of parts which should operate freely, and so on.
- (2) Test. The instructions in this paragraph should include references to the performance data listed in paragraph 6-19.b. Stress the concept that overhaul of an end item is aimed at returning equipment to new condition performance-wise. Give specific instructions on performance tests required to control the quality of overhaul maintenance procedures.

Table 0-0. Preventive Maintenance Services Chart

Sequence Number	Task Description	Reference	<u>Maintenance Schedule^{1/}</u>		
			D	W	M
1	Shelter Inspect and Clean Inventory Resupply	TM 5410-14/1 paragraph xxx	X		X X
2	Mounting Tracks Inspect Disassemble Clean Reassemble	TM 5410-14/1 paragraph xxx			X X X X
3	Door Hinges Inspect Disassemble Clean (vacuum) Reassemble	TM 5410-14/1 paragraph xxx			X X X X
4	Latches Inspect Disassemble Clean (vacuum) Reassemble	TM 5410-14/1 paragraph xxx			X X X X
5	Shelter Corners Inspect Clean (vacuum)	TM 5410-14/1 paragraph xxx			X X
6	Equipment Panels Inspect Clean (vacuum)	TM 5410-14/1 paragraph xxx		X	X
7	Table Tops Inspect and Clean	TM 5410-14/1 paragraph xxx	X		
8	Light Fixtures Inspect Disassemble Clean Reassemble	TM 5410-14/1 paragraph xxx			X X X X

^{1/} D = Daily; W = Weekly; and M = Monthly

Figure 6-1. Sample of Preventive Maintenance Services Chart

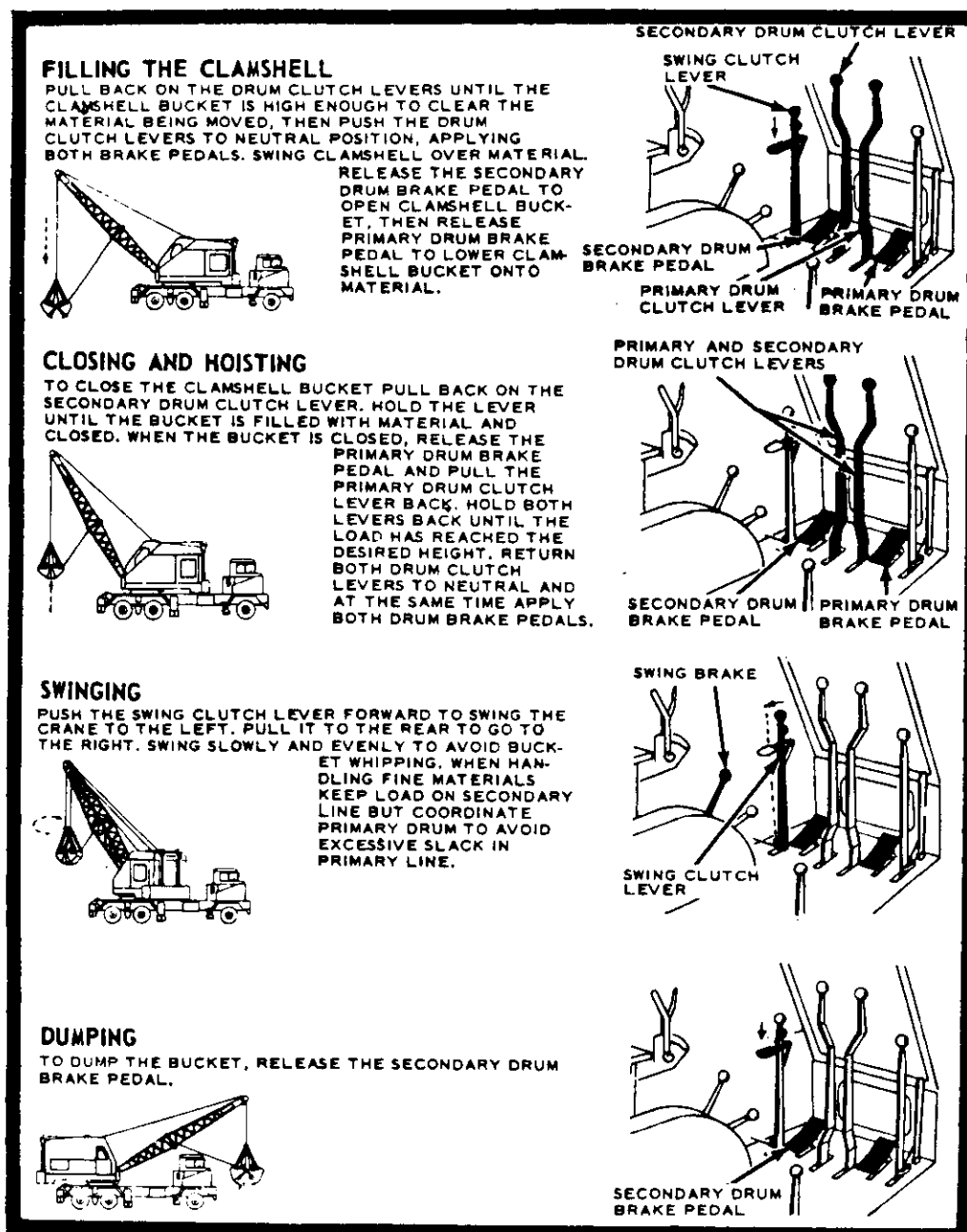


Figure 6-2. Sample of Typical Picture-Guide Technique Used in Operating Instructions

Table 0-0. Troubleshooting

Malfunction	Probable Cause	Possible remedy
MAIN ENGINE		
1. Engine fails to crank.	a. Master switch off. b. Batteries discharge.	a. Make sure master switch is turned on (para. 4-5). b. Recharge or replace batteries (para. 3-24 and 3-25).
2. Engine cranks but fails to start.	a. Fuel tank pump not operating. b. Water in fuel tanks. c. Engine cranks slowly. d. Engine underprimed.	a. Repair or replace pump as necessary. b. Drain tanks (para. 3-15) and refill with fresh fuel. c. Wrong grade of oil for prevailing temperature. Drain engine and refill with correct grade of oil (para. 3-19). d. Check operation of priming system. Look for plugged nozzles in cylinders and for broken or damaged lines or filters.
3. Engine backfires.	a. Water in fuel tanks. b. Moisture in magnetos or cracked internal parts.	a. Drain tanks (para. 4-25) and refill with fresh fuel. b. Wipe magnetos dry. Replace damaged parts.
AUXILIARY GENERATOR ENGINE		
1. Engine will not start.	a. Cylinder flooded. b. Faulty ignition.	a. Turn off magneto switch, open throttle wide, and crank engine intermittently. b. Clean, adjust, or replace breaker points. Clean, adjust, or replace spark plug. Replace condenser. Retime ignition.
2. Engine does not develop full power.	a. Dirty carburetor air cleaner. b. Choked muffler.	a. Remove air cleaner and clean (para. 4-40). b. Clean or replace muffler.

Figure 6-3. Sample of Troubleshooting Table

0-0. TABULATED DATA

a. GENERATOR CLASSIFICATION AND RATING.

Rated kw (kilowatts) 1.5 at 3,600 rpm (revolutions per minute)

Voltage. 28 vdc (volts direct current)

Current 52 amps (amperes)

Cooling. Fan

Lubrication type. Sealed bearings

Duty classification Continuous

Degree of enclosure Fully enclosed

Drive. Direct

b. GENERATOR REBUILD DATA.

(1) Field winding:

Type of winding Shunt

Size and type of wire. No. 28 heavy Formvar, or equivalent, 1 lb 5 oz (pound-ounce); No. 12 single cotton enameled wire 2 oz

Number of windings 4

Number of turns per winding . . 2375

Insulation type Paper insulation, 10 in. (inches), cambric and paper combination

Insulation sleeving Red, No. 4d

Insulation tubing. 1-1/2-mm (millimeter), 7-1/2 in. long, spaghetti type, (two); 5-mm, 1-3/4 in. long, spaghetti type (two)

Figure 6-4. Sample of Tabulated Data (Sheet 1 of 6)

Tape	Tape: varnished, cambric, 4 ft (feet), non-adhesive, insulation type, 0.007 in. by 1-1/8 in. wide Tape: Electrical, 6 ft, adhesive, insulation type EB, 1/2 in. wide Tape: Electrical, 6 ft, adhesive, 7 in., insulation type EJ, 1 in. wide Tape: white rayon, 14 ft, nonslip Kappa No. 9365 or equivalent, 0.005 in. thick by 3/4 in. wide
Dipping and material specification.	Double dip in Acme black varnish, or equivalent, and bake for length of time and at temperature prescribed
Leads, connectors, terminals . .	2 leads No. 12 stranded lead wire in Rockbestos fire ball or equal, 12 in. long

(2) Armature:

Armature unit weight	10-1/4 lb
Type of winding	Simplex lap
Coils per slot	3
Slots per core	29
Number of coils	87
Laminations	104
Slot wedge.	29
Slot insulation	29
Number of commutator bars. . .	87
Commutator pitch.	1-2

Figure 6-4. Sample of Tabulated Data (Sheet 2 of 6)

Core pitch.	1-8
Insulation type.	1, 250-v dielectric
Size and type of wire.	No. 17 heavy Formvar, natural, 1 lb 2 oz; No. 17 heavy Formvar, yellow, 1 lb 2 oz; No. 17 heavy Formvar, green, 1 lb 2 oz
Taping type.	Black, friction. . 6-3/4 ft Jonflex 9-3/4 ft Cotton 3 ft
Cord type	Linen No. 3. . . . 17 yd Linen No. 7. . . . 5 ft
Sleeving	No. 4 red or white . . 1/2 oz
Material specification.	Double reversed dip im- pregnation Sterling M- 830 varnish or equal, one sealer coat Sterling nuclear varnish.

(3) Engine repair and replacement standards.

Table 0-0 lists manufacturer's sizes, tolerances, clearance, and the maximum allowable wear and clearance.

(The example table below does not indicate all necessary data for the unit being described but is shown for the example purposes).

Figure 6-4. Sample of Tabulated Data (Sheet 3 of 6)

NOTE: The following tables will be on separate pages in the manual.

Table 0-0. ENGINE REPAIR AND REBUILD DATA

	Manufacturer's dimensions and tolerances in inches		Desired Clearance		Maximum allowable wear and clearance
	Min	Max	Min	Max	
Cylinder					
Bore.	2.625	2.628			
Out-of-round	-----	0.0005	-----	-----	0.005
Taper.	-----	0.0005	-----	-----	0.010
Clearance be- tween cylinder and piston as- sembly.	-----	-----	0.004	0.007	
Piston As- sembly Side Clear- ance for piston rings in grooves	-----	-----	0.0025	0.0040	
End clearance with piston rings in place.	-----	-----	0.008	0.020	
Piston ring tension	6-1/2 lb	9-1/2 lb			
Crankshaft					
End clearance.	-----	-----	0.002	0.004	0.010
Main Bearing					
Clearance	-----	-----	0.001	0.0035	0.005

Figure 6-4. Sample of Tabulated Data (Sheet 4 of 6)

Table 0-0. TIME STANDARDS

Remove and Replace	Man-Hours
01 ENGINES	
0101 CRANKCASE, BLOCK, CYLINDER HEAD	
Crankcase assembly	5.6
(includes removal and installation of crankshaft and bearings)	
Head, cylinder	1.0
(includes removal and installation of cylinder shield)	
0102 CRANKSHAFT	
Crankshaft and bearings	5.4
(includes removal and installation of generator, rod assembly, and flywheel)	
0103 FLYWHEEL ASSEMBLY	
Flywheel, crankshaft	1.5
(includes removal and installation of generator, muffler, carburetor, and crankcase)	
Housing assembly, fan	1.7
(includes removal and installation of engine and generator)	
0104 PISTONS, CONNECTING RODS	
Pistons, internal combustion engine . .	2.0
(includes removal and installation of manifold, carburetor, cylinder shield, and cylinder head)	
Rod assembly, connecting	4.0
(includes removal and installation of piston, magneto, and timer bracket)	

Figure 6-4. Sample of Tabulated Data (Sheet 5 of 6)

Table 0-0. TIME STANDARDS (Continued)

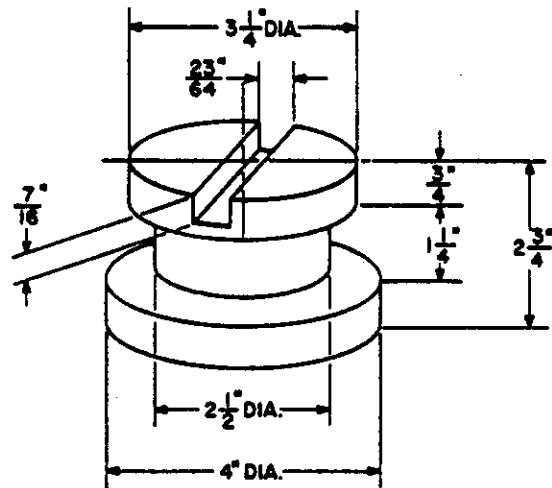
Remove and Replace	Man-Hours
0108 MANIFOLDS	
Manifold assembly, exhaust (includes removal and installation of muffler and manifold tubes)	0.8
Tubes, manifold heater	0.2
0111.1 HAND OR CRANKING DEVICES	
Plate, starter	0.1
03 FUEL SYSTEM	
0301 CARBURETOR, FUEL INJECTOR	
Carburetor, float (includes removal and installation of air cleaner and air cleaner adapter)	0.6
0304 AIR CLEANER	
Adapter, air cleaner (includes removal and installation of air cleaner)	0.2

Figure 6-4. Sample of Tabulated Data (Sheet 6 of 6)

Table 4-2 SPECIAL TOOLS AND EQUIPMENT

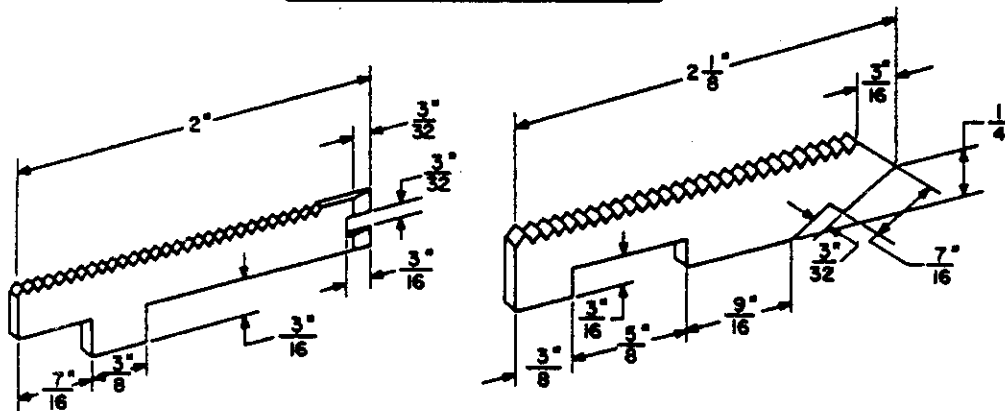
ITEM	NSN or JAN No.	REF. Fig.	APPLICATION
Compressor, valve spring	(72582)J-1227-A	4-7	Valve spring removal and installation
Remove, injector	(72582)J-1462	4-5	Fuel injector removal
Expander, crank shaft rear oil seal	(72582)J-1359	4-39	Flywheel housing installation
Generator, align- ment	(72582)J-1179	4-42	Realignment generator
Piston, ring removal	(72582)J-1569	4-48	Piston ring removal

Figure 6-5. Sample of Special Tools and Equipment Table



HORIZONTAL PRISM CARRIER ADJUSTING TOOL

MATERIAL - HARD WOOD



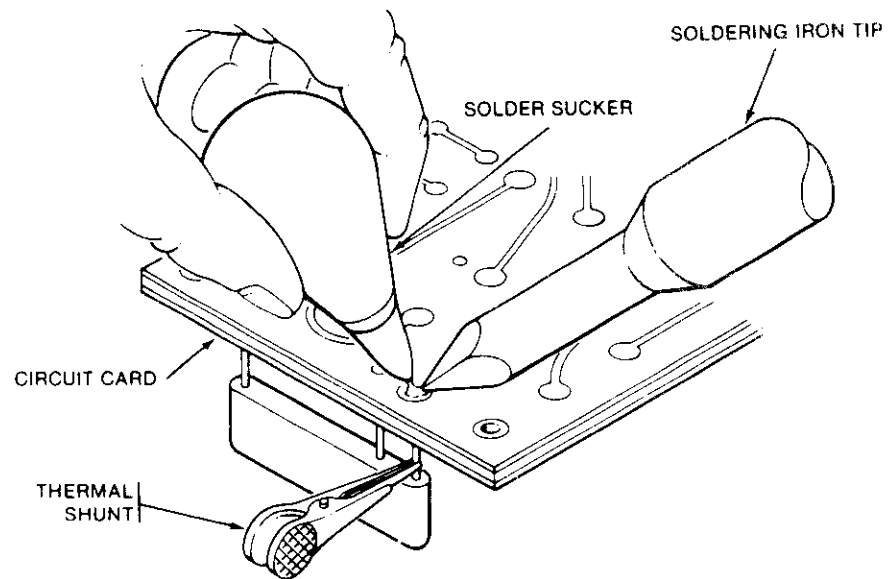
ADJUSTING & ASSEMBLY TOOL

MAKE FROM HACKSAW BLADE

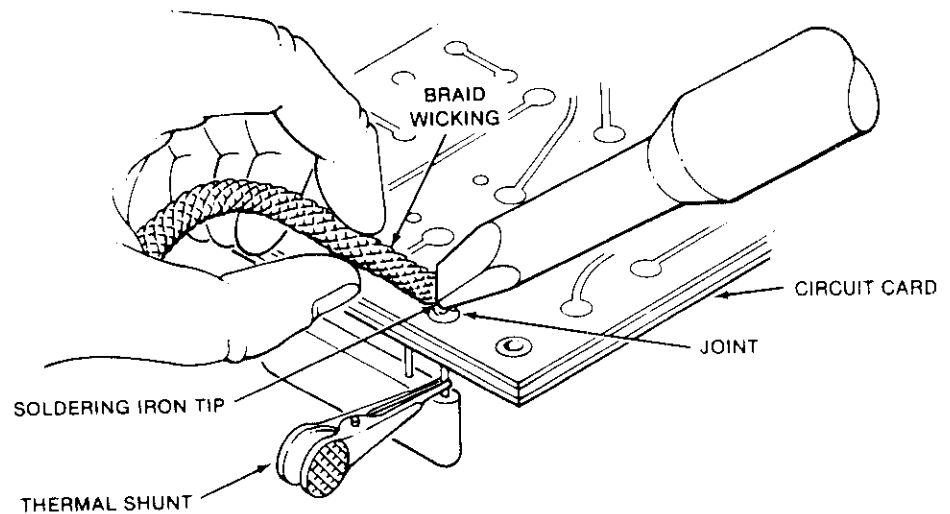
ADJUSTING & ASSEMBLY TOOL

MAKE FROM HACKSAW BLADE

Figure 6-6. Sample of Figure for Fabricated Tools and Equipment



- A. Using solder sucker to remove solder from lead joint.
1. Heat joint while compressing solder sucking bulb.
 2. Release bulb to suck up molten solder.
 3. Pull out lead from pad hole with pliers.



- B. Using braid wicking to remove solder from lead joint.
1. Heat joint until molten solder flows into rosin-coated braid.
 2. Remove braid and pull out lead from pad hole with pliers.

Figure 6-7. Sample of Picture-Guide Technique Used
in Depot Maintenance

PART VII. TECHNICAL CONTENT - TYPE II MANUALS

Type II manuals cover the installation, operation, maintenance, and repair of electronics equipment. The technical content of Type IA. manuals and Type II manuals differs in only a few areas. The chapters that differ (Chapters 1, 3, 4, and 6) are presented below. Chapters 2, 5, 7, and 8 do not change.

Arrange the technical contents of the manual as follows:

7-1. CHAPTER HEADINGS

- a. Chapter 1. General Information and Safety Precautions
- b. Chapter 2. Installation
- c. Chapter 3. Functional Description
- d. Chapter 4. Operation
- e. Chapter 5. Scheduled Maintenance
- f. Chapter 6. Troubleshooting
- g. Chapter 7. Corrective Maintenance
- h. Chapter 8. Repair Parts List.

Chapter 1. General Information and Safety Precautions

7-2. CHAPTER 1. GENERAL INFORMATION AND SAFETY PRECAUTIONS

All safety precautions necessary for the protection of personnel and equipment shall be included or cross-referenced as the initial paragraph(s) ahead of the introduction. Divide this chapter into two sections as follows:

- a. Section I. Introduction
- b. Section II. Equipment Description.

Provide an explanation of the purpose, scope, supersedure data, and applicability of the technical manual. Include, as well, the models, serial numbers, and configurations covered. State the interface relationship of the technical manual to other referenced publications. State the relationship of the equipment to referenced systems

7-3. SECTION I. INTRODUCTION

or other equipment. Include warranty/guarantee information, as applicable.

**7-4. SECTION II.
EQUIPMENT
DESCRIPTION**

Describe the intended use, capabilities, and limitations of the equipment. Keep text covering physical description or structural arrangements brief. Avoid unnecessary or repetitious details that are easily illustrated. The equipment and all of its units shall be clearly identified. If the technical manual covers more than one equipment configuration, provide a table defining the differences. The equipment description must include the following information:

**7-4.a. Equipment
Illustration**

- a. Equipment Illustration. Include an illustration representing all units comprising the equipment (see figure 5-1). Make the illustration a left-hand full page or foldout page (never backed up) and shall be assigned the folio (Blank/1-0). In the illustration, show the:

- (1) Major units of the equipment
- (2) Relative size of each unit
- (3) Basic interconnections between units
- (4) Relationship of units with other equipment.

7-4.b. Reference Data

- b. Reference Data. Include the following data in tabular form:

- (1) Descriptive (nameplate data). State the equipment manufacturer, type, model, and Marine Corps identification number, as applicable.
- (2) Functional. State such characteristics as power requirements, horsepower, pressure, capacity, modes of operation, power output,

frequency, pulse, sensitivity, selectivity, and applicable tolerances.

- (3) Capabilities and Limitations. State such information as pounds of thrust, miles per hour, turning radius, minimum and maximum ranges, degrees of coverage, resolution and accuracy, as applicable.
- (4) Rated Outputs. State such information as wattages, voltages, horsepower and gallons per minute, as applicable.
- (5) Environmental. State such characteristics as ambient temperatures, heat dissipation per unit, and humidity limits.

c. Equipment, Accessories, and Documents Supplied.

Provide a tabular listing of the equipment, its units, and accessories (special tools, test equipment, miscellaneous parts, government furnished items and publications) which form a part of or are supplied with the equipment. Set up the table as follows:

- (1) Column 1, Quantity. State the quantity of each unit and accessories supplied with the equipment.
- (2) Column 2, Item Name or Nomenclature. State the official name or nomenclature (name and designation) of each component, unit or accessory.
- (3) Column 3, Marine Corps Identification Number. State this number for each equipment unit or accessory, as available.
- (4) Column 4, Overall Dimensions. State the crated (if available) and uncrated height, width, and depth in inches (or inches and centimeters) of each unit or accessory.

**7-4.c. Equipment,
Accessories,
and Documents
Supplied**

(5) Column 5, Weight and Volume. State the crated (if available) and uncrated weight and volume in cubic feet of each unit and accessory.

**7-4.d. Equipment,
Accessories,
and Documents
Not Supplied**

d. Equipment, Accessories, and Documents Not Supplied. Include a tabular listing of all test equipment and publications required but not supplied. Set up the table as follows:

(1) Column 1, Category. State the name of each piece of equipment required.

(2) Column 2, Recommended Equipment. State the government nomenclature of the recommended equipment.

(3) Column 3, Alternate. State the government nomenclature of alternate test equipment.

(4) Column 4, Equipment Test Parameters. State the range of equipment parameters which must be satisfied by the test equipment item (not the range of the test equipment).

(5) Column 5, Application. State the intended use of the equipment (e.g., scheduled maintenance, troubleshooting, corrective maintenance, or installation).

**7-5. RELATED ITEMS
NOT SUPPLIED**

Describe equipment, accessories, and related publications not furnished with the basic equipment that the manual covers, but which have an important relationship to it. Provide enough detail to establish their physical and functional relationship to the basic equipment.

Chapter 2. Installation	7-6. CHAPTER 2. INSTALLATION
Refer to paragraph 5-6.	
Refer to paragraph 5-7.	7-7. SITE SELECTION
Refer to paragraph 5-8.	7-8. REFERENCE PUB- LICATIONS
Refer to paragraph 5-9.	7-9. TOOLS AND MATERIAL REQUIRED
Refer to paragraph 5-10.	7-10. UNPACKING AND REPACKING
Refer to paragraph 5-11.	7-11. PREPARATION OF FOUNDA- TIONS
Refer to paragraph 5-12.	7-12. INPUT REQUIREMENTS
Refer to paragraph 5-13.	7-13. INSTALLATION PROCEDURES
Refer to paragraph 5-14.	7-14. INSTALLATION CHECKOUT
Refer to paragraph 5-14.a.	7-14.a. Phase 1. Installation, Inspection and Pre-Energizing Procedures

**7-14.b. Phase 2. Initial
Turn-on and
Preliminary
Tests**

Refer to paragraph 5-14.b.

**7-14.c. Phase 3.
Installation
Verification
Tests**

Refer to paragraph 5-14.c.

**7-15. CHAPTER 3.
FUNCTIONAL
DESCRIPTION**

Chapter 3. Functional Description

This chapter includes a detailed analysis of the principles of operation of the overall equipment and its major functions. Describe the development of the equipment outputs (e.g., transmit, receiving, control, cooling, etc.) in each mode of operation. The structure and organization shall parallel Chapter 6, Troubleshooting. The text shall refer to and support the functional troubleshooting diagrams in Chapter 6. Present the descriptions in successive levels of increasing detail as follows:

7-15.a. Overall Level

- a. Level 1 (Overall Level). Describe all major equipment functions and supporting functions. Text shall support and refer to the overall functional diagram.

**7-15.b. Major Functional
Level**

- b. Level 2 (Major Functional Level). Describe the development of each equipment output at the level of detail shown on its related signal flow diagram, logic diagram, or other diagrams included in Chapter 6. The text shall support and refer directly to the diagram. (See paragraph 5-15.c.(2).)

- c. Level 3. (Circuit Level). Briefly describe conventional electronic circuits found in applicable USASI publications (see paragraph 1-4.c(2)). Support the description by reference to the maintenance schematic diagrams identified in Chapter 6. Describe in detail circuits not covered in applicable USASI publication. Support the description with simplified schematic diagrams (see paragraph 5-15.b). Describe alternating current (ac) and direct current (dc) power distribution in detail. Support the descriptions by reference to the power distribution diagrams in paragraph 5-28.f. Describe mechanical devices, cooling systems, etc. Support the descriptions by reference to the overall functional block diagrams identified in paragraphs 5-15.b and 5-15.c.

7-15.c. Circuit Level**Chapter 4. Operation**

In this chapter, include all the procedures necessary to enable operating personnel to use the equipment properly and to understand its operation. Provide enough detail to allow operators, not trained on the equipment, to operate it independently and safely without additional explanation. Chapter 4 contains four sections as follows:

- a. Section I. Introduction
- b. Section II. Controls and Indicators
- c. Section III. Operating Procedures
- d. Section IV. Operator's Maintenance Instructions and Schedules.

Describe the operator's relationship to the equipment. Identify those units having controls and indicators that the

**7-16. CHAPTER 4.
OPERATION****7-17. SECTION I.
INTRODUCTION**

operator must use for performance of duties. Support the introduction with illustrations and tables that identify and locate all operator controls and indicators. Explain the intended function and application of the equipment so that the operator will know exactly what they should expect to accomplish with the equipment. The following sections identify in detail what the operation instructions entail:

**7-18. SECTION II.
CONTROLS AND
INDICATORS**

A description of all operator controls, indicators, protective devices and jacks shall include the following:

- a. Names of panel designations as marked on the equipment.
- b. Positions and operating functions for each control, and the normal operating condition of each indicator in each of the operating functions.
- c. Detailed illustrations to support the text. (See figure 5-10.)
- d. Operator's Controls and Indicators table (see figure 5-11) that references illustration in which figure appears, item, and function.
- e. When operation requires more than one person, indicate the designated position and function of each. Specify the relationship between control and indicators, and position and function, for each operator.

**7-19. SECTION III.
OPERATING
PROCEDURES**

Provide the following information on operating procedures:

**7-19.a. Operator
Turn-On**

- a. Operator Turn-On. Include all steps necessary to bring equipment from OFF through STANDBY condition to full operation.

-
- | | |
|---|--|
| <p>b. <u>Modes of Operation</u>. State procedures for each mode of operation, e.g. manual, automatic, local, remote, etc. Describe the use and relative advantage of each mode of operation.</p> <p>c. <u>Operation Under Interfering Conditions</u>. Describe equipment anti-jamming and interference reduction features. Describe advantages of each feature and operating procedures to be followed in all possible situations. Include supporting illustrations (e.g., indicator displays, waveforms, etc.) that provide typical observations of jamming and interference for evaluation by the operator.</p> <p>d. <u>Operator Turn-Off</u>. Include all steps necessary to bring equipment from full operation through STANDBY to OFF condition.</p> <p>e. <u>Emergency Operation</u>. Cover operation of equipment during emergency conditions (e.g., control failure, air failure, lube oil failure). Include emergency operation instructions. Provide a warning or caution to return the equipment to proper operation when the emergency is over.</p> <p>f. <u>Emergency Turn-Off</u>. Explain how to turn equipment off during an emergency (e.g., fire, water, smoke, hazard to personnel, loss of coolant, normal power, etc.).</p> <p>g. <u>Method of Presentation</u>. Operating procedures shall be presented in tabular form and shall be in concise, simply-worded, step-by-step procedures and shall include the following:</p> <p style="margin-left: 40px;">(1) A short explanation of the operation to be performed.</p> <p style="margin-left: 40px;">(2) Initial safety requirements (actions, inspections, and reference to emergency turn-off procedures).</p> | <p>7-19.b. Modes of Operation</p>
<p>7-19.c. Operation Under Interfering Conditions</p>
<p>7-19.d. Operator Turn-Off</p>
<p>7-19.e. Emergency Operation</p>
<p>7-19.f. Emergency Turn-Off</p>
<p>7-19.g. Method of Presentation</p> |
|---|--|

- (3) Connection of any accessory equipment not permanently connected.
- (4) Instructions for obtaining or confirming the presence of all critical inputs such as power, coolant, air, signal, air conditioning, etc.
- (5) Procedures for setting controls and making adjustments which must be accomplished by the operator prior to equipment turn-on.
- (6) Procedures for determining operational readiness and the acceptable indications expected from built-in indicators such as meters, lamps, gages, cathode ray tubes, and recorder readouts.
- (7) Milestones in the operational status of the equipment shall be identified and included by brief statements such as the "the generator is now in STANDBY."
- (8) Visual or aural observations which occur as a result of an operator action, such as boom lowering, sweep rotation, blower motor running, etc.
- (9) Procedures that can be hazardous to personnel or equipment shall be emphasized by WARNINGS or CAUTIONS placed immediately prior to the specific step involving the possible hazard. "Notes" shall not be used.
- (10) Illustrative material supporting the procedures shall identify and locate all operating controls and indicating devices as well as normal in-use positions or indications.
- (11) Operator's checks and adjustments in proper sequence.
- (12) Operator's maintenance actions and schedules.

Provide the following information for General Operator's Maintenance Instructions and Schedules:

**7-20. SECTION IV.
OPERATOR'S
MAINTENANCE
INSTRUCTIONS
AND SCHEDULES**

- a. General. These instructions shall define maintenance tasks and schedules to be performed by the operator. The maintenance tasks shall be limited in scope such that they will not be in conflict with operational commitment; will not be beyond technical training; will not be dangerous; will not be the responsibility of the maintenance technician; and will not potentially compromise the operation of the equipment. Normally these tasks will be restricted to minor adjustments, cleaning, filter replacement, servicing and lubrication.
- b. Method of Presentation. Maintenance procedures shall be presented in tabular form and shall be in concise, simply-worded, step-by-step procedures and shall include the following:
- (1) A short explanation of the task to be performed.
 - (2) Initial safety requirements (actions, inspections, and reference to emergency turn-off procedures).
 - (3) Separately identified and defined steps for each task and major sub-routine.
 - (4) A limit of 10 steps to each identified task or sub-task.
 - (5) Procedures that can be hazardous to personnel or equipment shall be emphasized by WARNINGS or CAUTIONS placed immediately

7-20.a. General

**7-20.b. Method of
Presentation**

prior to the specific step involving the possible hazard. "Notes" shall not be used.

(6) Illustrative material supporting the procedures shall identify and locate all maintenance points with clear pictorials showing essential details.

(7) Reference to the standard log sheet.

**7-21. CHAPTER 5.
SCHEDULED
MAINTENANCE**

Chapter 5. Scheduled Maintenance

Refer to paragraph 5-21.

**7-22. SECTION I.
INTRODUCTION**

Refer to paragraph 5-22.

**7-23. SECTION II.
TOOLS AND
EQUIPMENT**

Refer to paragraph 5-23.

**7-24. SECTION III.
ORGANIZATIONAL
AND INTERMEDIATE
LEVEL MAINTENANCE**

Refer to paragraph 5-24.

**7-24.a. Organizational
Maintenance**

Refer to paragraph 5-24.a.

7-24.b. Introduction

Refer to paragraph 5-24.b.

**7-24.c. Scheduled
Maintenance
Action Index**

Refer to paragraph 5-24.c.

**7-24.d. Preventive
Maintenance
Procedures**

Refer to paragraph 5-24.d.

**7-24.e. Scheduled
Performance Tests**

Refer to paragraph 5-24.e.

**7-24.f. Intermediate
Maintenance**

Refer to paragraph 5-24.f.

Refer to paragraph 5-24.g.

Refer to paragraph 5-24.h.

Refer to paragraph 5-25.

**7-24.g. Maintenance
Inspections**

7-24.h. Schedule

**7-25. SECTION IV.
CARE AND
PREPARATION
FOR STORAGE/
SHIPMENT**

Chapter 6. Troubleshooting

This chapter shall contain all the information required to enable the technician to locate malfunctions in the equipment. Provide the following troubleshooting data:

- a. Introduction. The introduction shall explain the logic of the troubleshooting procedures presented in the manual. Describe the troubleshooting data and indicate how they relate to one another.
- b. Troubleshooting Index. Present the troubleshooting index in tabular form. List all equipment with major and supporting functions. Provide references to the appropriate procedures and diagrams to be used to troubleshoot a specific function (see figure 7-1).
- c. Relay and Lamp Indexes. Prepare these indexes in tabular form for all relay coils and indicator lamps. Include the item reference designation, the functional name, energizing voltage, and a reference to the troubleshooting diagram (see figure 7-2.)
- d. Protective Device Index. List all protective devices, such as fuses, circuit breakers, etc. Include the item reference designator, front panel marking of the device, trip-out value of the circuit breaker

**7-26. CHAPTER 6.
TROUBLE-
SHOOTING**

7-26.a. Introduction

**7-26.b. Troubleshooting
Index**

**7-26.c. Relay and Lamp
Indexes**

**7-26.d. Protective
Device Index**

**7-26.e. Maintenance
Turn-On
Procedure**

and rating of fuses, name of the circuit protected, and a reference to the troubleshooting diagrams (see figure 7-3).

- e. Maintenance Turn-On Procedure. Include maintenance turn-on procedure to go from the fully de-energized condition to full operation (see figure 7-4). This procedure must enable the technician to determine which major or supporting function is not working properly.

- (1) In each step of the procedure, include the action to be taken (STEP) and the observation to be made (OBSERVE).
- (2) Reference the troubleshooting procedure or corrective action (REFERENCE) to be followed if the observation is out of tolerance.
- (3) Direct user to observe built-in monitoring such as meters, dials, lamps, etc., for making observations as opposed to the use of external test equipment. The procedure is complete when the equipment is fully energized and all switches and controls are positioned for proper operation.

**7-27. TROUBLESHOOTING
PROCEDURES**

Troubleshooting procedures shall be directly related to, and support the troubleshooting diagrams and shall provide a logical guide for isolation of faults. List step-by-step procedures for troubleshooting. Direct the technician to observe meters, fuses, circuit breakers, valves, and other available indicators that would show the presence of trouble. Provide complete instructions on signal tracing for electric circuits including the use of special test instruments and unusual servicing techniques. This information may be in tabular, illustrative, or narrative form. (See figure 5-13.)

Troubleshooting diagrams shall consist of the following, as required:

**7-28. TROUBLE-
SHOOTING
DIAGRAMS**

- a. Signal Flow Diagrams. Provide detailed block diagrams illustrating the functional development of each equipment output from its origin to its measurable output (see figure 7-5). Begin the flow path with one or more initial inputs (or appropriate interface conditions) and proceed through each unit, assembly, and subassembly influencing the signal flow. Each hardware block must reference a schematic diagram to isolate the faulty part. Identify all items shown on the signal flow diagram by their reference designations as shown below:

**7-28.a. Signal Flow
Diagrams**

- (1) Titles of diagrams must correspond to the signal flow described.
- (2) Diagrams must depict such signal flow as receive, transmit, RHI display, PPI display, bearing data, antenna rotation, and elevation data.
- (3) Show all test points necessary to isolate the trouble to the lowest level of hardware block (e.g., subassembly). Include test parameters required to define satisfactory operation. Where signal flow diagrams depict signal flow in more than one mode of operation, present test data on the page apron for all modes. Apron notes must also include test data for test equipment setup.
- (4) References must be made to the functional description, troubleshooting procedures, and corrective actions by paragraph number. Normally these references must be included with the notes.

- (5) The display of more than one function or mode of operation on one diagram is allowed only when clarity is not sacrificed and the functions are relatively simple.
- (6) Show screwdriver adjustments, dial adjustments, and adjustable controls.
- (7) Place the reference designation (e.g., 1A1A2) in each hardware block. Include the reference to the figure number of the schematic diagram adjacent to the reference designation.
- (8) Show all input/output signals and connectors and terminals in the signal path. Identify the signal, and show all lead numbers, connector numbers, and terminal identifiers.
- (9) Show all built-in controls and monitoring devices. Do not show external test equipment, unless it is a permanent part of the equipment.
- (10) Show chassis grounds, signal grounds, and power grounds.
- (11) Identify all leads of motors, generators, synchros, etc.
- (12) Show all relay coils that are energized by the signal.
- (13) Show and identify all relay contacts and relay terminals in the flow chart. Depict all relay contacts in the operational mode. Show references to control diagrams on which the relay coils appear adjacent to the relay contacts.
- (14) Show and identify all switches which affect signal flow. Show switch terminals and panel markings corresponding to the switch positions.
- (15) Show mechanical couplings of all controls, switches, potentiometers, synchros, etc.

- (16) Identify signal paths by weighted lines and arrowheads.

- b. Piping Diagrams. See paragraph 5-15.b(2).
- c. Control Diagrams. Include control diagrams (see figure 5-18) for all control circuits. Group circuits according to energizing voltage, control function, mode of operation, or physical limits of cabinet or assembly, as applicable. Provide supporting information required to clarify the use of the diagram in the general notes. Include the functional name and reference designation for each relay, switch, lamp, etc., illustrated. Show all relay energizing circuits with all tie points and terminals, and with switches and relay contacts, in their operating positions. Show all terminal connections, switches, interlocks, contacts or other relays in a series with the energizing path, plus lamps or indicators (electrically connected in the energizing or indicating status of contact closures). Place the following note on all control diagrams: "All switches and relay circuits are shown in operating positions."
- d. Power Distribution Diagrams. Power distribution diagrams (see figure 5-19) depict the distribution of primary ac power, secondary ac power, and dc power from the terminal board, breaker, or fuse box to the various subassemblies or modules of the equipment. Normally, a separate diagram must be prepared for each voltage level used within the equipment. The following rules apply in the preparation of power distribution diagrams:

7-28.b. Piping Diagrams

7-28.c. Control Diagrams

**7-28.d. Power
Distribution
Diagrams**

- (1) Show and identify motors, transformers, regulators, power supplies, assemblies, subassemblies and modules.
- (2) Show and identify all power line devices such as fuses, circuit breakers, switches, and relay contacts.
- (3) Show and identify all connections including plugs, jacks, and terminal boards in the distribution path.
- (4) Use dot and dash lines to set off hardware boundaries such as units, assemblies, and subassemblies. Identify each unit, assembly, and subassembly by reference designation. Reference the schematic diagram covering the unit, assembly, and subassembly.
- (5) Reference all relay contacts to the appropriate control diagrams. All relay contacts must be shown in the operating condition.
- (6) Include voltages and tolerances, as required.
- (7) Show and identify all metering circuits and indicators.
- (8) Show all grounds, commons, neutrals, and return lines.
- (9) Whenever practicable, display the power path from left to right and from top to bottom.
- (10) The functional names of all "main line" switches and circuit breakers must be conspicuously marked on the diagram. In addition, set off any power control markings engraved or stencilled on the equipment in a rectangular box, for example, "MAIN POWER."
- (11) Show all relay coils in series with the main power distribution path. Relay control

circuits shown on control diagrams need not be repeated on distribution diagrams.

- (12) Place the following note on all control diagrams: "All switches and relay circuits are shown in operating positions."

e. Maintenance Schematic Diagrams. Maintenance schematic diagrams include unit-to-unit interconnection diagrams, intra-unit interconnection diagrams, and unit, assembly, and subassembly schematic diagrams. These diagrams must provide complete coverage of the equipment. (See figure 5-20 of this manual and figure 25 of MIL-M-15071H for maintenance schematic diagrams.)

**7-28.e. Maintenance
Schematic
Diagrams**

- (1) Draw the schematic diagram for each unit so that, together with the interconnecting diagrams, all circuits elements are included and all circuits can be traced from unit to unit.
- (2) Zone schematic diagrams by alphanumeric coordinates. Include location of all circuit elements by zones in a table located on the apron. When a part such as a relay or a twin tube is drawn in sections at different locations, list as many coordinates as necessary to locate all sections.
- (3) Represent major and minor signal paths by different line weights. Use the heavier line weight to show the major signal path. Make signal flow from left to right and from top to bottom whenever possible. Place arrowheads denoting the direction of signal flow on the signal flow lines.

- (4) The use of ground and voltage busses is discouraged except in the power supply. However, voltage bus connections can be shown by broken lines directly beneath the connection. As a substitute for ground busses, use individual grounds and include appropriate notes to indicate sources.
- (5) Show all significant voltages at busses, tube pins, and transistor elements except when this data can be presented best in a voltage chart. Indicate whether the voltage is ac (alternating current) or rf (radio frequency). Show dc (direct current) voltages by polarity.
- (6) Mark the functional names of all operating controls and adjustments conspicuously on the schematic, for example, "VERT CENT, BIAS ADJ." In addition, set off any operating front panel markings on the equipment in a rectangular box, for example, "RF GAIN, AGC ADJ." Include the functional name of all stages (tubes, transistors, etc.).
- (7) Identify and indicate the function, source, and destination of all input and output circuits by figure number.
- (8) Designate power and signal frequencies in Hertz (Hz). Note resistance values, if more than one ohm, for all wire-wound devices such as motors, relay coils, and transformers. Give tolerances for all valves (\pm tolerances).
- (9) Indicate rated current and voltage values of primary and secondary windings of power transformers.
- (10) Provide a resistance and voltage chart for a schematic diagram on the page apron. This chart must give the normal resistance and

voltage to ground (or other points of significance) for each tube socket pin with acceptable tolerances. In addition, list all conditions which affect the resistance or voltage values given, such as control settings, equipment connections, tubes removed from sockets, etc. If semiconductors (transistors, diodes, etc.) are employed in circuits, adequate caution notices must be included to prevent damage to these devices when making resistance measurements in the circuit. No intra-element resistance measurements (i.e., between emitter, base, and collector) are required to be made on transistors themselves. Also, indicate resistance of power supply busses and other points of significance.

- (11) Identify each schematic diagram by the reference designation number, located in the lower right-hand corner of the image area.
- (12) Present schematic diagrams in alphanumeric order corresponding to the reference designation of units, assemblies, subassemblies, etc. When two or more identical assemblies or modules are used, redundant schematic diagrams need not be repeated. However, a table that cross-references the reference designation to the figure number of the common schematic diagram must be provided immediately preceding the schematic diagram. For identification purposes, schematic diagrams covering more than one unit, assembly, or module must include, in the lower right-hand corner of the illustration, all the reference designations of the unit, assemblies, and

modules to which they refer, e.g., 1, 1A1, 2A7, 3A19.

- (13) Group circuit elements functionally and arrange them to make signal flow obvious from left to right and top to bottom. Do not arrange circuit elements to fill up white space or to maintain tube or transistor alignment. Arrange circuit elements in textbook form for the convenience of the user. Do not distort layout to achieve fit.

7-28.f. Logic Diagrams

- f. Logic Diagrams. Provide logic diagrams for digital devices and digital aspects of conventional equipment. (See figure 5-21 of this manual and figure 30 of MIL-M-15071H for logic diagrams.)

7-28.g. Control Cycle Diagrams

- g. Control Cycle Diagrams. Control cycle diagrams (see figure 5-22) of digital equipment must show the entire cycle on a single, signal flow logic diagram together with an appropriate note describing key operating features.

7-28.h. Timing Circuits Diagrams

- h. Timing Circuits Diagrams. Provide timing circuits diagrams (see figure 5-23) for all significant timing relationships. These diagrams must show the exact timing relationships and the origins of all timing signals (conventional and digital).

7-28.i. Single-Function Diagrams

- i. Single-Function Diagrams. Logic diagrams for nonprogrammable devices, which result in a unique output function, may be prepared to the requirements of signal flow diagrams.

7-28.j. Module Logic Diagrams

- j. Module Logic Diagrams. Provide module logic diagrams for all modules.

7-28.k. Flow Charts

- k. Flow Charts. Provide flow charts for digital devices to support the explanation of machine instructions and test programs. The flow charts must conform to USASI X3.5.

- l. Coding Instruction Sheets. Provide coding instruction sheets (see figure 5-24) for all programs. The listing must contain all coding and address data as well as an adequate notes section to ensure understanding.
- m. Test Programs. Test programs with coding instruction sheets shall be developed and included to support troubleshooting procedures, as required.

Chapter 7. Corrective Maintenance

Refer to paragraph 5-29.

Refer to paragraph 5-30.

Refer to paragraph 5-31.

Refer to paragraph 5-32.

Refer to paragraph 5-33.

Chapter 8. Repair Parts List

Refer to paragraph 5-34.

Refer to paragraph 5-35.

7-28.l. Coding Instruction Sheets

7-28.m. Test Programs

7-29. CHAPTER 7. CORRECTIVE MAINTENANCE

7-30. SECTION I. INTRODUCTION

7-31. SECTION II. ADJUSTMENTS AND ALIGNMENTS

7-32. SECTION III. REPAIR

7-33. SUPPORTING ILLUSTRATIONS AND DATA

7-34. CHAPTER 8. REPAIR PARTS LIST

7-35. SECTION I. ITEM IDENTIFI- CATION LISTING

7-35.a. Item Number	Refer to paragraph 5-35.a.
7-35.b. Model	Refer to paragraph 5-35.b.
7-35.c. Stock Number	Refer to paragraph 5-35.c.
7-35.d. Reference Designator	Refer to paragraph 5-35.d.
7-35.e. Indenture Code	Refer to paragraph 5-35.e.
7-35.f. Item Identification	Refer to paragraph 5-35.f.
7-35.g. Unit of Measure	Refer to paragraph 5-35.g.
7-35.h. Quantity	Refer to paragraph 5-35.h.
7-35.i. Source Maintenance Recoverability Code	Refer to paragraph 5-35.i.
7-35.j. Special Stockage Indicator Code	Refer to paragraph 5-35.j.
7-35.k. Replacement Factor	Refer to paragraph 5-35.k.
7-36. SECTION II. ITEM NUMBER CROSS-REFERENCE	Refer to paragraph 5-36.
7-37. SECTION III. NATIONAL STOCK NUMBER CROSS- REFERENCE	Refer to paragraph 5-37.
7-38. SECTION IV. PART NUMBER CROSS-REFERENCE	Refer to paragraph 5-38.
7-39. SECTION V. CIRCUIT SYMBOL NUMBER TO ITEM NUMBER CROSS- REFERENCE	Refer to paragraph 5-39.

Refer to paragraph 5-40.

**7-40. ASSEMBLY/
SUBASSEMBLY
ILLUSTRATIONS**

Refer to paragraph 5-40.a.

7-40.a. Callouts

Refer to paragraph 5-40.b.

7-40.b. Exploded Views

Refer to paragraph 5-40.c.

**7-40.c. Line Drawings and
Photographs**

Refer to paragraph 5-40.d.

**7-40.d. Printed Circuit
Board**

Table 3-1. Troubleshooting Index

Function/Equipment	Table/Diagram/Schematic	Table/Figure/FO Number
1. AC Power	Fault Isolation Procedures Fault Logic Diagram Schematic AC Power Distribution Wiring Diagram AC Power Wiring Diagram Power Panel Wiring Diagram Power Distribution	Table 3-5 FO-8 FO-2 FO-6 FO-7 FO-3
2. DC Power	Fault Logic Diagram Wiring Diagram Power Supply Selector Switch	FO-9 Figure 2-15
3. Air Conditioner	Fault Logic Diagram Fault Isolation Procedures	FO-10 Table 3-21
4. Lighting	Fault Logic Diagram Schematic Lighting System	FO-11 Figure 2-18
5. VFCT, Transmit, Options 1 and 2	Fault Isolation Procedures Fault Logic Diagram Data Function/Signal Flow Diagram,	Table 3-6 FO-13 FO-20
6. VFCT, Receive Options 1 and 2	Fault Isolation Procedures Fault Logic Diagram Data Function/Signal Flow Diagram,	Table 3-7 FO-14 FO-21
7. FSK, Transmit Options 3 and 4	Fault Isolation Procedures Fault Logic Diagram Data Function/Signal Flow Diagram	Table 3-8 FO-15 FO-22
8. FSK, Receive Options 3 and 4	Fault Isolation Diagram Fault Logic Diagram Data Function/Signal Flow Diagram	Table 3-9 FO-16 FO-23

Figure 7-1. Sample of Troubleshooting Index

Table 3-2. Relay and Lamp Index

Reference	Functional Name	Energizing Voltage	Troubleshooting Figure/FO Number	
<u>AC Power Subsystem</u>				
A1K1	Voltage Relay	115 Vac	FO-2, FO-6	
A1K2	Voltage Sensitive Relay	115 Vac	FO-2, FO-6	
DS1	Shelter Lighting	115 Vac	FO-2, FO-3 Figure 2-18	
DS2	Shelter Lighting	115 Vac	FO-2, FO-3 Figure 2-18	
<u>DC Power Subsystem</u>				
Power Supply Control				
XDS1	Power Supply A Indicator	120 Vdc	Figure 2-15	
XDS2	Power Supply B Indicator	120 Vdc	Figure 2-15	
<u>Control Subsystem</u>				
Key Control Unit, FSK UCC-1				
XDS1	XMTR	POWER	115 Vac	Figure 2-17
XDS2	XMTR	POWER	115 Vac	Figure 2-17
XDS3	XMTR	POWER	115 Vac	Figure 2-17
XDS4	UCC-1	CONTROL	115 Vac	Figure 2-17
XDS5	FSK-1	CONTROL	115 Vac	Figure 2-17
XDS6	FSK-1	CONTROL	115 Vac	Figure 2-17

Figure 7-2. Sample of Relay and Lamp Index

Table 3-3. Protective Device Index

Designators	Front Panel Marking	Rating Volts	Amps	Circuit Protected	Troubleshooting FO Number
AC Power Subsystem					
A1CB1	Main	204 Vac	50	All AC circuits in shelter	FO-2, FO-7
A1CB2	Lights	115 Vac	20	Shelter lighting	FO-3, FO-7
A1CB3	Receptacle	115 Vac	20	RCPT No. 1 and No. 2	FO-3, FO-7
A1CB4	Teletype	115 Vac	20	TTY RCPT No. 1 and No. 2, UGC-48	FO-3, FO-7
A1CB5	Air Conditioner	204 Vac	20	Air Conditioner	FO-3, FO-7
A1CB6	CAB No. 4	115 Vac	20	Equipment Cabinet No. 4	FO-3, FO-7
A1CB7	CAB No. 3	115 Vac	20	Equipment Cabinet No. 3	FO-3, FO-7
A1CB8	CAB No. 2	115 Vac	20	Equipment Cabinet No. 2	FO-3, FO-7
A1CB9	CAB No. 1	115 Vac	20	Equipment Cabinet No. 1	FO-3, FO-7

Figure 7-3. Sample of Protective Device Index

Table 3-4. Maintenance Turn-on Procedures

Step	Observe or Perform	Reference
1. Preliminary Procedures		
a. Place all circuit breakers on power panel to OFF position.		
b. Ensure proper connection between generator or shipboard power to shelter external connector.		
c. Place main power transfer switch S1 in position of external power being utilized.		
d. Activate external power.		
2. AC Power Distribution		
a. MAIN Circuit Breaker A1CB1 ON.		
b. LIGHTS Circuit Breaker A1CB2 ON.	Shelter lighting DS1 and DS2 light.	FO-3
c. Voltmeter A1M1	115 Vac	FO-2
d. Frequency Meter A1M2	60 Hz	FO-2
e. AIR CONDITIONER Circuit Breaker A1CB5 to ON.		FO-3
1. A/E32C-17 Air Conditioner Selector Switch to COOL	Air Conditioner turns on. Cool air distributed through ducts.	
2. A/E32C-17 Air Conditioner Selector Switch to HEAT.	Warm air distributed through ducts.	
3. DC Power Distribution		
a. Place POWER switch on both P-345B/UG Power Supplies to ON position.	Both power supply lights lit.	Figure 2-15
b. Place Power Supply Selector Switch to POWER SUPPLY A position.	Both power supply indicator lights (XDS1 and XDS2) lit.	Figure 2-15

Figure 7-4. Sample of Maintenance Turn-On Procedures Table

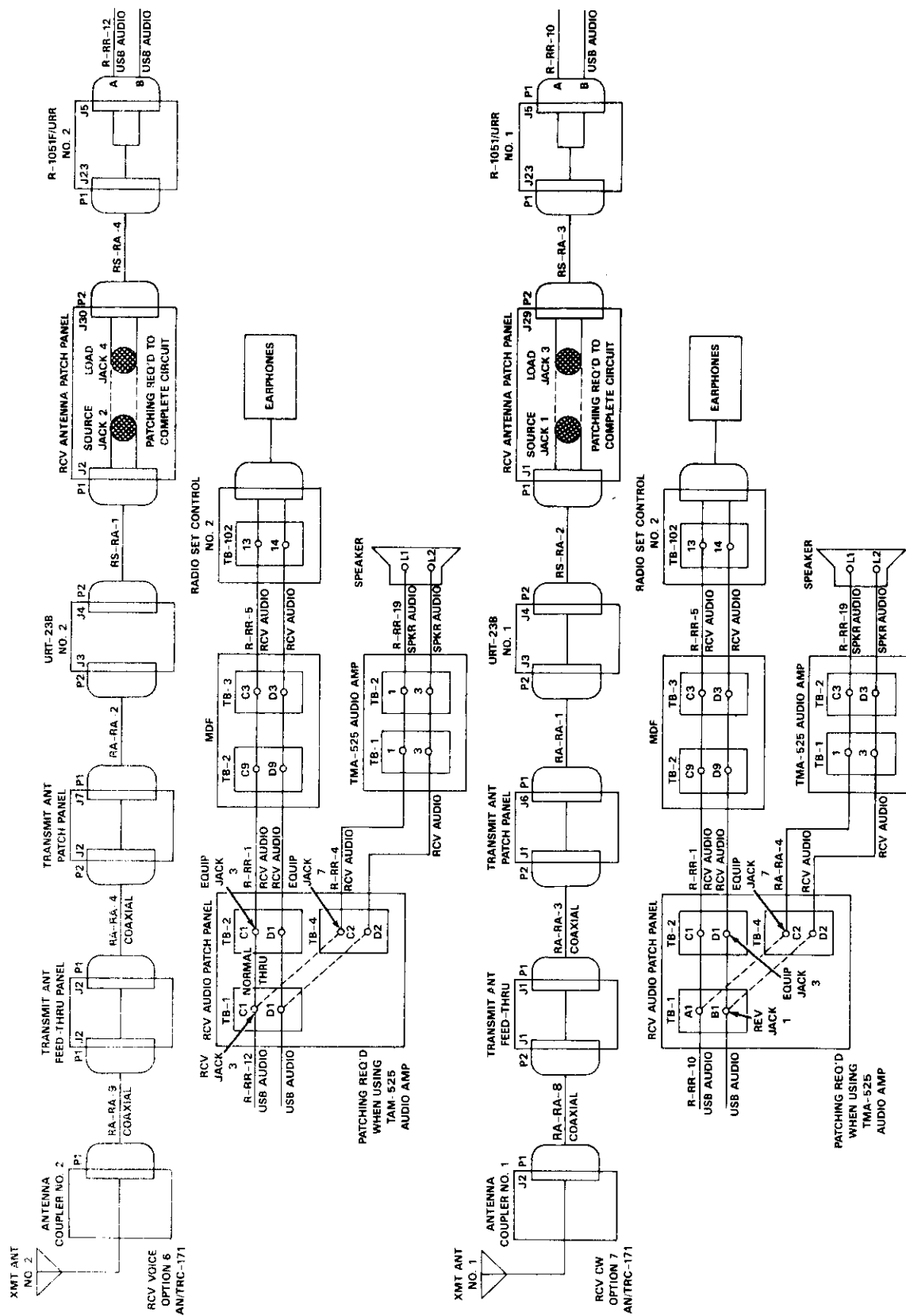


Figure 7-5. Sample of Signal Flow Diagram

PART VIII. TECHNICAL CONTENT - TYPE III MANUALS

The following pages explain the technical content of Type III manuals which are systems manuals. A system is defined as two or more equipment sets or major components, each having its own identity and nomenclature, arranged and interconnected to perform a specific operation. Systems manuals provide system-oriented instructions for operation, maintenance, installation, and test data. Detailed equipment data should be provided by reference to the equipment manuals. However, technical data must be developed at the equipment level and be included for all equipment system, subsystem, and interface components not covered by an equipment technical manual.

Arrange the technical contents of the manual as follows:

8-1. CHAPTER HEADINGS

- a. Chapter 1. General Information
- b. Chapter 2. Safety Precautions
- c. Chapter 3. Installation
- d. Chapter 4. Functional Description
- e. Chapter 5. Operation
- f. Chapter 6. Scheduled Maintenance
- g. Chapter 7. Fault Isolation
- h. Chapter 8. Alignment Procedures/Corrective Maintenance
- i. Chapter 9. Repair Parts List.

Chapter 1. General Information

8-2. CHAPTER 1. GENERAL INFORMATION

This chapter describes the system in general physical and functional terms. It contains the information as specified below.

Define the system and its relationship with other systems. State the mission of the system. Support the text with diagram(s) showing the interrelationships of the system equipment. Indicate the major functional relationship and

8-3. INTRODUCTION

inputs and outputs to related systems. This section must also address the following topics:

**8-3.a. Physical
Arrangement**

- a. Physical Arrangement. Describe the system areas and compartments, and list the system equipment and units contained in those areas. Use illustrations to support the physical arrangement description. Provide separate illustrations of each compartment and area that identify the listed system equipment. Other equipment, which is installed in the subject system compartments and areas, need not be listed in the text or called out in the illustrations if it does not directly affect the operation or maintenance of the subject system.

**8-3.b. System
Equipment**

- b. System Equipment. Identify and describe the equipment comprising the system. Descriptions of the equipment that the operator attends must include general statements on the nature and purpose of units and indicators. Use illustrations to support the text. Show all equipment in relative-scale proportion, whenever possible. Equipment may be separately illustrated with significant features called out if such details are necessary for proper support of the text.

**8-3.c. Associated-
System Equipment**

- c. Associated-System Equipment. When descriptions and illustrations of associated-system equipment are required, limit them to the major units. Make the descriptions more condensed than those of subject system equipment. Otherwise, the same requirements are applicable. In the descriptions, emphasize the associated system equipment that constitutes an operational or functional interface with the subject system. Include such units in the system illustrations.

- d. Reference Data. Include a list of equipment comprising the system and its official designations. Provide a list of common names of abbreviated or informal nomenclature. Include system characteristics together with a list of reference publications as follows:

- (1) Capabilities. Provide a summary of system capabilities. Include data such as gallons per minute, transfer per hour, boom capacity, rated ranges, resolution, accuracy, data handling capability, number of channels, etc. Present the data in tabular form.
- (2) Reference Publications. Provide a list of manuals that pertain to the system and system equipment. Include other documents of interest, such as training manuals and manuals for associated system equipment. The list of publications must include the title and publication number of the referenced publications.

Chapter 2. Safety Precautions

This chapter includes descriptions of system hazards and precautions that are addressed to system personnel and referenced to particular system equipment. Organize the descriptions to be consistent with operation of the system. Descriptions must supplement and extend equipment safety instructions to the system level by warning of potential hazards that can be caused during operation or maintenance.

8-3.d. Reference Data

8-4. CHAPTER 2. SAFETY PRECAUTIONS

- a. Include a summary that emphasizes the proper use of equipment controls, describes the hazards to operators or, as applicable, the hazards to persons in areas remote from the operation. The summary must also recommend precautions. Include an emergency operational routine emphasizing controls that permit immediate braking or de-energizing of the system.
- b. Stress proper use of controls. Describe hazards to maintenance personnel, potential damage to equipment, and recommend precautions.
- c. Identify and briefly describe hazardous components including radioactive devices and elements used with the system. Summarize general handling precautions for such components. The description of a hazardous component must include brief statements as to the purpose, manner of function, nature of built-in safety devices, and nature of the hazardous element. It must also indicate the relative sensitivity of the component to mechanical shock, vibration, electromagnetic and radioactive radiation, and electrostatic discharges.

**8-5. CHAPTER 3.
INSTALLATION**

Chapter 3. Installation

This chapter provides the information necessary for proper system installation that does not appear in the equipment technical manuals. Illustrations are the principal means of conveying information. Text is supportive to the illustrations. This chapter covers the following topics:

- a. Installation Data
- b. Installation Checkout.

Include installation drawings and information not contained in the equipment technical manuals that are necessary to install and check out the system. System installation data must contain the following:

- a. Utilities List. Include a utilities list that presents in tabular form all utilities required, and the quantities in each system, compartment, and area.
- b. Interconnection Diagrams. Present interconnection block diagrams with each equipment or component shown as a block. Identify all cables running between equipment by cable number. Include the number of active and spare leads in each cable. Also indicate all junction boxes, switchboards, etc., into which interconnection cables enter or leave.
- c. Cable Run Diagrams. Use isometric diagrams to indicate the location of all cable runs between compartments or areas. Each cable run diagram must show, by deck, compartment, and frame identification, the location of all cables shown on the interconnecting diagrams.
- d. System Piping Run Diagrams. Use isometric diagrams to indicate the location of all system piping runs between compartments and areas. Each piping run diagram must indicate, by deck, compartment, and frame identification, the location of all pipes, valves, fittings, tanks, etc.
- e. System Cable Interconnection Check. Provide cold-wire check procedures to verify the proper installation of all system cables. Prepare these checks for conduct with all power off and all equipment completely shut down.
- f. Active System Tests. Include all active system test procedures required to verify the proper installation

8-6. INSTALLATION DATA

8-6.a. Utilities List

8-6.b. Interconnection Diagrams

8-6.c. Cable Run Diagrams

8-6.d. System Piping Run Diagrams

8-6.e. System Cable Interconnection

8-6.f. Active System Tests

**8-6.g. System Component
Installation
Procedures**

and operation of the system. Reference applicable tests and procedures. Provide complete procedures for setup, testing, shutdown, and data analysis.

- g. System Component Installation Procedures. Provide complete step-by-step instructions for installation of system components not covered in any of the manuals to the system equipment. Include the following types of supplemental information not provided in the equipment technical manuals:

- (1) Instructions required to assemble components.
- (2) Instructions required to mount components. Include boring and bracing diagrams and data on shock mounts.
- (3) Instructions for making electrical, waveguide, plumbing and all other interface connections between equipments, components, and other systems.
- (4) Servicing procedures, such as initial lubrication and adjustments.
- (5) Instructions for bonding and grounding. The following drawings must be included:
 - (a) Pictorial diagrams.
 - (b) Outline and mounting dimensions data.
 - (c) Interconnecting wiring and cabling diagrams.
 - (d) Primary power distribution diagrams.
 - (e) Piping diagrams.

**8-7. INSTALLATION
CHECKOUT**

Provide step-by-step procedures to demonstrate that the system operates correctly and within tolerances. These procedures must provide for system checkout in three test phases as follows:

-
- a. Phase 1. Installation, Inspection and Pre-Energizing Procedures. Provide inspection procedures in the form of checklists to ensure that:

- (1) The system and required auxiliary equipment have been installed. Check to see that their location and orientation are proper; that all cables, antennas, waveguides, transmission lines, dehydrators, coolant lines, piping, etc., have been installed in accordance with plans and specifications. Be sure that continuity exists in all interconnections.
- (2) Calibrated test equipment, specially designed for this system, available and operating satisfactorily.
- (3) All field changes and mandatory retrofits have been accomplished.
- (4) All rotating devices are free from obstruction.
- (5) There is access to the system for maintenance.
- (6) All pre-energizing servicing procedures, including lubrication, have been accomplished.
- (7) It is safe to turn on the system.

- b. Phase 2. Initial Turn-On and Preliminary Tests. Include step-by-step procedures for energizing the system for the first time. Applicable portions of Chapter 4 may be referenced. Include step-by-step procedures for testing the system electrical supply circuits including distribution panels, switches, breakers, relief valves, and interlocks. Include procedures for testing piping, electrical cables, wire rope, and stays. Also give procedures for proper installation of transmission lines and waveguides, hangar spacing, torquing of connectors, pressure testing, flow rates, standing wave ratio, attenuation checks, etc.

**8-7.a. Phase 1.
Installation,
Inspection and
Pre-Energizing
Procedures**

**8-7.b. Phase 2. Initial
Turn-On and
Preliminary Tests**

8-7.c. Phase 3.**Installation
Verification
Tests**

- c. Phase 3. Installation Verification Tests. Include complete instructions for testing the system in all modes of operation. Procedures must cover the checking of gauges, meters, alarms, and other sensing devices for proper operation and calibration. These tests must verify that all inputs are in tolerance. Where applicable, include voltage standing wave ratio (VSWR) and insertion loss tests to verify the proper installation of antenna-to-equipment waveguide runs. Include transducer impedance and source level checks to verify proper installation of transducers, domes, and cables. Include preliminary set-up data in each procedure. When a required alignment must be accomplished before performing a test, include or reference it in the procedure. Present test procedures in a logical order as follows:

- (1) Energize the system.
- (2) Test the first units (normally power supplies) which must be operating properly. When test results are within the required tolerance, reference the next logical test. Also reference the corrective maintenance or troubleshooting data to be used if test results are not within tolerance.

**8-8. CHAPTER 4.
FUNCTIONAL
DESCRIPTION****Chapter 4. Functional Description**

In this chapter describe how the components or equipment comprising the system jointly perform major operations and functions, and how associated systems contribute to the performance of these major functions. Describe equipment of associated system interfaces only as necessary to identify the sources or destination of

system inputs and outputs. Do not repeat the functional description provided in the equipment manuals. Discuss each major function separately at progressively increasing levels of detail. Support the description of the entire system with a basic block diagram (see figure 8-1). Where information can be presented better pictorially than by text, use additional diagrams and illustrations. This chapter will focus on two major areas:

- a. System Function Directory. A system function directory tabulates operator control functions. Tabulation includes the following information, as applicable:

- (1) Official name of the function, colloquial name, and symbol.
- (2) Type of control or signal (ac frequency and voltage, dc polarity and voltage, hydraulic pressure, mechanical motion, synchro, etc.).
- (3) Origin and termination of the control or signal.
- (4) Identity of equipment (relay transmitters, coordinate converters, distribution boxes, switches, and the like) between the origin and termination of the output control or signal.
- (5) Figure numbers of illustrations on which the function is illustrated, including fault isolation diagrams.

- b. Functional Description. Describe each function on at least two levels of detail:

- (1) First Level Description. Confine the first level of the description to data such as origin of the function at an equipment control or

**8-8.a. System Function
Directory**

**8-8.b. Functional
Description**

sensor; transmission of the signal via intermediate equipment such as switchboards, relay transmitters, coordinate converters, and distribution boxes; and presentation of the function at terminal equipment. Introduce control functions essential to the development of a signal and briefly describe them in their relationship to the signal. Support the description with a block diagram (see figure 8-2). Illustrate the diagrams for electrical/mechanical systems as shown in figure 8-3). Explain functions involving computations in mathematical terms but at a level no higher than high school mathematics.

- (2) (Detailed) Second Level Description. The detailed second level description explains the system functions in terms directly related to the diagrams in Chapter 6. Describe data and control functions down to the level of an item of equipment in an equipment group. Support functional descriptions of important parts of electrical/mechanical systems with illustrations similar to figure 8-4.

8-9. CHAPTER 5. OPERATION

Chapter 5. Operation

Include all procedures necessary to enable operating personnel to use the system properly. Provide enough detail to allow operators, not trained on the system, to operate it independently and safely without additional explanation. Chapter 5 may be divided into sections when required as in complex systems:

- a. Section I. Pre-Operational Conditions and Setup
- b. Section II. Operating Modes
- c. Section III. Operating Procedures.

Establish specific preoperational conditions presumed to be in effect prior to system operation. A system readiness checkoff list of significant switch positions and indicator status must be tabulated. For indicators such as dials, where a band of readings is possible, delineate upper and lower limits. Treat initial conditions of associated-system equipment that directly affect system operation in a similar manner.

**8-10. SECTION I.
PRE-OPERATIONAL
CONDITIONS
AND SETUP**

Describe the primary operating mode in detail. Treat alternate modes as modifications of the primary mode. Operating procedures common to all modes must be detailed under the primary mode. Refer to them under the alternate modes, with such modifications of procedures as may be necessary. Describe each mode in the logical sequence of major phases, events, options, supervisory commands, and responsive actions and the following:

**8-11. SECTION II.
OPERATING
MODES**

- a. Explain only those operator controls and indicators having system significance. When controls must be actuated and indicators observed in a sequence to achieve system operation, cite each control and indicator with a number to indicate the position in the sequence.
- b. Emphasize safe operation of controls with warning statements. Warnings must explain that improper operation could result in hazards to personnel or damage to the equipment. Each control must be followed by a brief description of its effects (equipment actuation or display indication, or both) at the operator station and at remote stations. Support the primary mode description with general and detailed illustrations.

- c. Illustrate operational phases involving operator judgment with operational logic diagrams. In the diagrams, indicate the conditions that must be favorable prior to an operator action. If unfavorable, indicate the alternate action. Include illustrations showing dials, gauges, status lights, etc., which show the favorable or unfavorable conditions. Describe special procedures for by-passing an equipment failure. (These special procedures are to be separate from emergency procedures).

**8-12. SECTION III.
OPERATING
PROCEDURES**

This section covers three major topics, as follows:

8-12.a. Normal Operation

- a.. Normal Operation. Describe the duties of system operators in terms of general responsibility and specific step-by-step procedures for operating the system in all of the primary modes. Descriptive words (such as switch, button, dial, or indicator) may be added to clarify the type of control involved, for example: "Press ACCESS button and observe channel spot." Discuss all system controls and indicators provided for the use of operators. Do not call out controls and indicators provided only for maintenance and nonsystem application.

**8-12.b. Emergency
Operation**

- b. Emergency Operation. Provide step-by-step procedures for emergency operation of the system. If specially designated controls have been provided for emergencies, include a short statement describing how they modify or otherwise affect normal system operation. Support emergency procedures with illustrations.

- c. Special Operation. Describe special operations such as test checkout, training, or evaluation exercises. Supporting illustrations must include block diagrams and pictorial diagrams.

8-12.c. Special Operation**Chapter 6. Scheduled Maintenance**

Chapter 6 shall contain all system scheduled test procedures, together with necessary explanations and illustrations. It is intended that the engineering effort required to develop preventive maintenance data be expended only once and that the data, where applicable, be used both in this chapter and in Maintenance Engineering Analysis (MEA), Logistic Support Analysis (LSA) and/or Maintenance Requirements Cards (MRC) where one or more of the latter three data items are required by the contract. The preparation of this chapter of the manual should therefore be delayed until completion of the MEA, LSA and/or MRC; submissions of the manual manuscript for review should be marked "TO BE SUPPLIED UPON COMPLETION OF LSA". When the approved MEA, LSA or MRC data is available, it shall be included in the manual in the identical technical content and, wherever practicable, in the identical format. When included in the manual, such MEA, LSA or MRC data shall be integrated with other technical data required by this specification to be in this chapter. These procedures shall be correlated with the installation checkout requirements, such that any maintenance or performance test procedure also required for checkout may be properly referenced from Chapter 3, Installation. Chapter 6 shall contain:

- a. Section I. Introduction
- b. Section II. Scheduled Maintenance Procedures

**8-13. CHAPTER 6.
SCHEDULED
MAINTENANCE**

- c. Section III. Care and Preparation for Storage/ Shipment.

**8-14. SECTION I.
INTRODUCTION**

The introduction shall be an explanation of the purpose, scope, and arrangement of the scheduled maintenance material. When a preventive maintenance procedure is critical to the operation of the system and the schedule for servicing is absolute (not recommended), this information shall be conspicuously written as a CAUTION. The following statement shall be included: "The scheduled maintenance instructions in this manual are intended to duplicate those furnished in the Planned Maintenance System (PMS)." In case of conflicts, the PMS documentation takes precedence. Such conflicts should be reported immediately on the user comment sheet in accordance with the maintenance procedures for this manual.

**8-15. SECTION II.
SCHEDULED
MAINTENANCE**

This section applies to all echelons of maintenance. State scheduled maintenance procedures in the form of maintenance check-off and performance standards. Coordinate with the Procuring Activity in preparing this information for the technical manual. Format the information according to the following paragraphs.

**8-15.a. Scheduled
Maintenance
Action Index**

- a. Scheduled Maintenance Action Index. This index is used to specify scheduled performance tests and scheduled maintenance procedures. Tabulate the index as follows (see figure 5-12):

- (1) Column 1, Interval. Provide an alphanumeric list of all maintenance actions contained in the chapter. Use the following interval symbols, as appropriate, in the order of increasing interval, as listed below:

<u>Interval</u>	<u>Symbols</u>
Hourly	H
Daily	D
Weekly	W
Monthly	M
Quarterly (3 months)	Q
Semiannually (6 months)	S
Annually (12 months)	A
Overhaul cycle	C
As specified (explain circumstances)	R ¹

¹Precede an R interval by a recommended calendar interval, e.g., daily as specified (DR), weekly as specified (WR), etc.

- (2) Column 2, Maintenance Action. List the maintenance action which corresponds to the interval number in column 1.
- (3) Column 3, Reference. State the paragraph or table number of the maintenance procedure that corresponds to the maintenance action in column 2.

b. Scheduled Tests Procedures. Include the detailed procedures for setting up and performing complete system tests. Each procedure shall be numbered and tested to clearly define the test action and the output to be tested. The procedures shall contain the data identified below:

- (1) Safety precautions
- (2) List of tools and test equipment identified by type, manufacturer, and model number

8-15.b. Scheduled Test Procedures

- (3) Minimum rating of the technician expected to perform the task
- (4) Title of the test to be performed
- (5) Preliminary set-up data required to perform the test
- (6) Detailed procedures for accomplishing the test. Procedures requiring lengthy and identical set-up data may be presented in detail in one procedure and referenced in succeeding procedures.
- (7) Values or conditions, with tolerances, indicative of normal operation
- (8) References to troubleshooting or corrective actions to be used if the test values are not within tolerances
- (9) Illustrations to support the test.

**8-16. SECTION III.
CARE AND
PREPARATION
FOR STORAGE/
SHIPMENT**

Include this section in all manuals covering intermediate maintenance or higher. Provide necessary instructions for preparing the system equipment for storage so that it will be adequately protected under prevailing climatic conditions. Include specially required technical inspection, cleaning, preservation, lubrication, weather-proofing, and any other special services necessary to prepare the equipment for storage. Address requirements for storage periods of up to three months as well as long-term storage requirements. In the latter, processing, packaging, and packing requirements will be more extensive. See paragraph 5-10 for information on preparation for shipment.

**8-17. CHAPTER 7.
FAULT
ISOLATION**

Chapter 7. Fault Isolation

This chapter contains fault isolation procedures and illustrations and explains the use of the information

presented. It describes the major objectives of the system fault isolation procedures and briefly explains each type of maintenance diagram used. Organize this chapter around the topics listed below:

- a. Operation-Based Symptom Fault Directory
- b. Fault-Isolation Procedures
- c. System Fault Logic Diagrams
- d. Troubleshooting - Maintenance Dependency - Matrix Chart
- e. System Control Function Diagrams
- f. System Data Function Diagrams.

The directory must relate system faults observed during operation to fault isolation diagrams. Set up the directory in tabular form by operational modes (see figure 8-5). Include references to system fault isolation diagrams, and where applicable, refer directly to equipment troubleshooting diagrams. Include the following information in the table, as appropriate.

- a. Table Headings. Identify table headings by the operational mode to which the table relates.
- b. Column Headings. The fault directory must contain the following columns:

- (1) Column 1, Operating Procedure Step. List only the operating procedure for which a fault symptom can be observed. For example, if step 1 is an action step (Set XYZ switch to ON), with no operational response, do not place step 1 in column 1. However, if step 1 states "Set XYZ switch to ON, and check to see that XYZ lamp lights," include step 1 in column 1.

8-18. OPERATION-BASED SYMPTOM FAULT DIRECTORY

8-18.a. Table Headings

8-18.b. Column Headings

- (2) Column 2, Functional Description. Include the reference to the paragraph number of the functional description in chapter 1. When an operation can be identified with an output, also include the name or symbol of the output.
- (3) Column 3, Fault Isolation Procedure. Reference the fault isolation procedure by paragraph number.
- (4) Column 4, Alignment Procedure (as applicable). Reference the alignment procedure by paragraph number.
- (5) Column 5, Fault Isolation Diagram. Reference the fault isolation diagram by figure and sheet number.
- (6) Column 6, Equipment Documentation. Reference the equipment technical manual when the fault can be isolated to the specific equipment causing the fault.

**8-19. FAULT
ISOLATION
PROCEDURES**

Include procedures for isolating trouble in a single equipment or functional area of an equipment. The procedures must provide for the analysis of switching combinations and observable indications (dials, gauge lamps, and meters). Describe the use of any required test equipment. The procedures must support the fault-logic, control-function, and data function diagrams. Reference the supporting diagrams by figure number. Prerequisite control settings and conditions must precede each procedure.

**8-20. SYSTEM
FAULT LOGIC
DIAGRAMS**

These diagrams are based on a fault indication that may be observed during troubleshooting (see paragraph 5-28.a). System fault logic diagrams comprise a branching series of questions on fault isolation. Each question pertains to a further observation or measurement, and results in a

"yes" or "no" answer. (Present tolerance values in those instances where a definitive "yes" or "no" cannot be obtained.) The series of questions progressively narrows the possible functional area of the equipment containing the fault. The user is then referred to that portion of the manual containing the information needed to complete fault isolation and repair. In each diagram include or reference the information necessary to establish test or operating conditions required for starting the fault isolation procedure. Use only three types of blocks as described below:

- a. Shaded Blocks. The right and bottom border lines of these blocks are weighted. In shaded blocks, place questions that may be answered from observation, without changing test setup and without special equipment.
- b. Single-Line Blocks. In these blocks, place questions requiring measurement with specially set-up external test equipment.
- c. Double-Line Blocks. These blocks are conclusion boxes. In them list the functional area within an item of equipment that is the probable source of malfunction. Reference a procedure or another diagram for further isolation or correction of a fault.

Matrix charts show the functional dependency of output signals or indications upon circuit elements, circuits, modules, etc. (see figure 5-15.) Present this chart in the form of a grid as follows:

8-20.a. Shaded Blocks

**8-20.b. Single-Line
Blocks**

**8-20.c. Double-Line
Blocks**

**8-21. SYSTEM
TROUBLE -
SHOOTING-
MAINTENANCE
DEPENDENCY -
MATRIX CHART**

- (1) Annotate each vertical column to represent a circuit element, circuit, module, etc.
- (2) Annotate the horizontal rows to represent a procedural step that results in an observable output or indication.
- (3) Use symbols in the body of the grid to show the relationship between circuit elements, circuits, etc., and observable output or indication.
- (4) Exercise all circuits, modules, etc., in a manner to permit logical diagnosis.
- (5) Clearly define all outputs and give performance specifications.
- (6) Define all symbols.
- (7) Fully explain use of the chart.

**8-22. SYSTEM CONTROL
FUNCTION
DIAGRAMS**

Provide control function diagrams for all system control circuits. Prepare them at the system level according to paragraph 5-28.e.

**8-23. SYSTEM DATA
FUNCTION
DIAGRAMS**

Show in detail the system information needed to isolate faults within signal or data flow paths. Include tolerance values and provide references to equipment publications, where necessary. Show all inputs required to develop the output. Construct data function diagrams in accordance with the following:

- a. Diagram titles must correspond to the signal flow described.
- b. Show all test points necessary to isolate the trouble to the lowest level of hardware block (e.g., subassembly). Include test parameters required to define satisfactory operation. Where diagrams depict signal flow in more than one mode of operation, present that data on the apron

- for all modes. Apron notes must also include test data for test equipment set up. All inputs and outputs must have signal description information.
- c. Reference functional description troubleshooting procedures, corrective actions, etc., as appropriate, by paragraph number. Normally, these references must be included.
 - d. Displaying more than one function or mode of operation on one diagram is allowed only when clarity is not sacrificed and functions are relatively simple.
 - e. Show screwdriver adjustments, dial adjustments, and adjustable controls.
 - f. Show all built-in controls and monitoring devices. Do not show external test equipment, unless it is a permanent part.
 - g. Show chassis grounds, signal grounds, and power grounds.
 - h. Identify all leads of motors, generators, synchros, etc.
 - i. Show all relay coils that are energized by the signal.
 - j. Show and identify all relay contacts and relay terminals in the flow path. Depict relay contacts in the operational mode. References to control diagrams on which the relay coils appear must be shown adjacent to the relay contacts.
 - k. Identify signal paths with weighted lines and arrowheads.

Chapter 8. Alignment Procedures/Corrective Maintenance

Present corrective adjustment procedures and supporting information necessary to restore electrical and mechanical alignment between various system equipment. Include all

8-24. CHAPTER 8. ALIGNMENT PROCEDURES/ CORRECTIVE MAINTENANCE

values and tolerances. Cross-reference alignments with respective fault isolation procedures and diagrams. Alignment procedures must include references to equipment publications when further procedures are required at the equipment level. Present alignment procedures in step-by-step form. Step by-step maintenance procedures for any and all items of equipment (which are a part of the system) not covered by individual manuals (government, commercial, or CFE) must be included in this chapter.

<p>8-25. CHAPTER 9. REPAIR PARTS LIST</p>	<p>Chapter 9. Repair Parts List</p>
	<p>Refer to paragraph 5-34.</p>
<p>8-26. SECTION I. ITEM IDENTIFICATION LISTING</p>	<p>Refer to paragraph 5-35.</p>
<p>8-26.a. Item Number</p>	<p>Refer to paragraph 5-35.a.</p>
<p>8-26.b. Model</p>	<p>Refer to paragraph 5-35.b.</p>
<p>8-26.c. Stock Number</p>	<p>Refer to paragraph 5-35.c.</p>
<p>8-26.d. Reference Designator</p>	<p>Refer to paragraph 5-35.d.</p>
<p>8-26.e. Indenture Code</p>	<p>Refer to paragraph 5-35.e.</p>
<p>8-26.f. Item Identification</p>	<p>Refer to paragraph 5-35.f.</p>
<p>8-26.g. Unit of Measure</p>	<p>Refer to paragraph 5-35.g.</p>
<p>8-26.h. Quantity</p>	<p>Refer to paragraph 5-35.h.</p>
<p>8-26.i. Source Maintenance Recoverability Code</p>	<p>Refer to paragraph 5-35.i.</p>
<p>8-26.j. Special Stockage Indicator Code</p>	<p>Refer to paragraph 5-35.j.</p>
<p>8-26.k. Replacement Factor</p>	<p>Refer to paragraph 5-35.k.</p>

Refer to paragraph 5-36.	8-27. SECTION II. ITEM NUMBER CROSS- REFERENCE
Refer to paragraph 5-37.	8-28. SECTION III. NATIONAL STOCK NUMBER CROSS-REFERENCE
Refer to paragraph 5-38.	8-29. SECTION IV. PART NUMBER CROSS-REFERENCE
Refer to paragraph 5-39.	8-30. SECTION V. CIRCUIT SYMBOL NUMBER TO ITEM NUMBER CROSS-REFERENCE
Refer to paragraph 5-40.	8-31. ASSEMBLY/ SUBASSEMBLY ILLUSTRATIONS
Refer to paragraph 5-40.a.	8-31.a. Callouts
Refer to paragraph 5-40.b.	8-31.b. Exploded Views
Refer to paragraph 5-40.c.	8-31.c. Line Drawings and Photographs
Refer to paragraph 5-40.d.	8-31.d. Printed Circuit Board
Refer to paragraph 5-42	8-32. INDEX

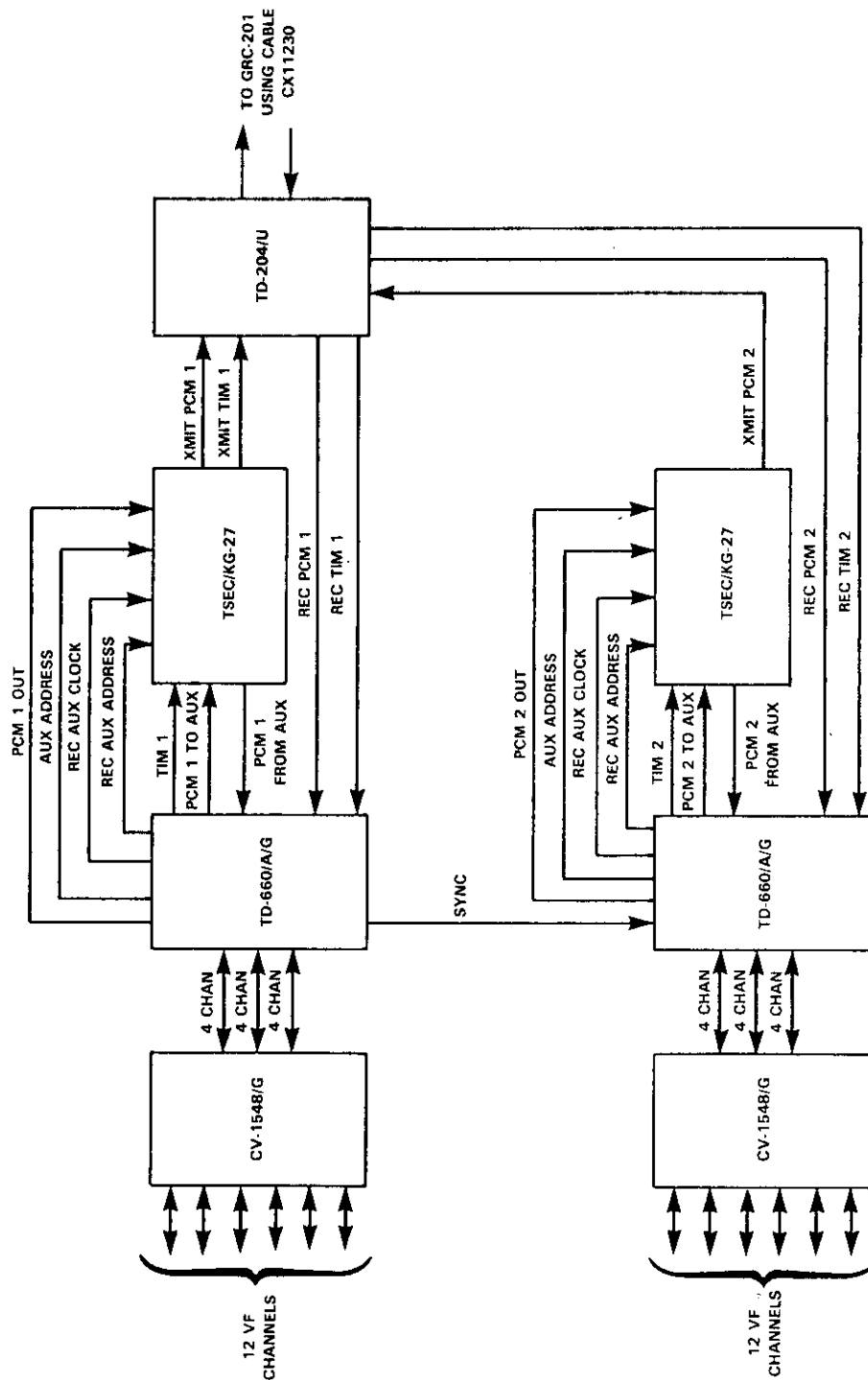


Figure 8-1. Sample of System Functional Block Diagram

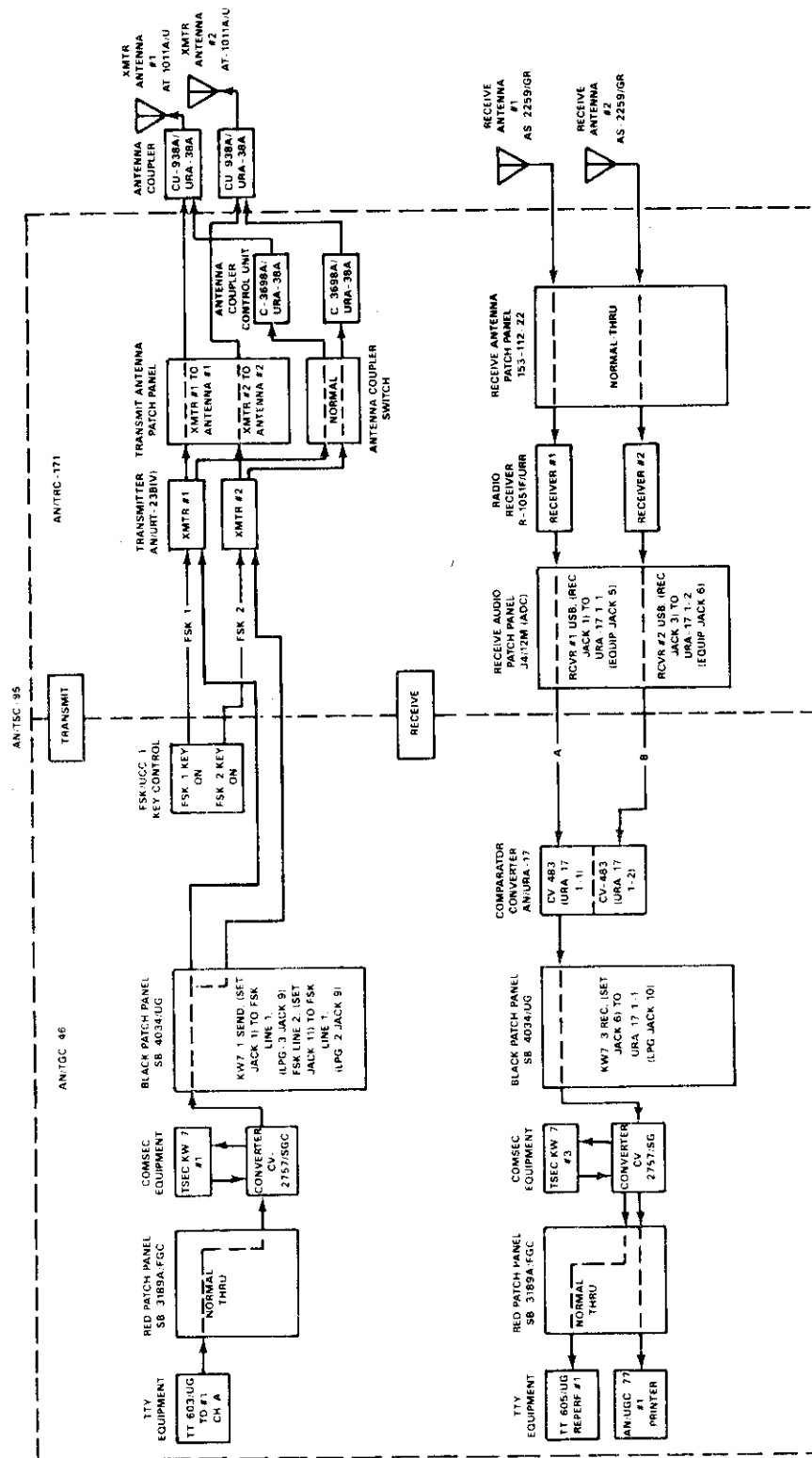


Figure 8-2. Sample of First Level Functional Description Electronic System

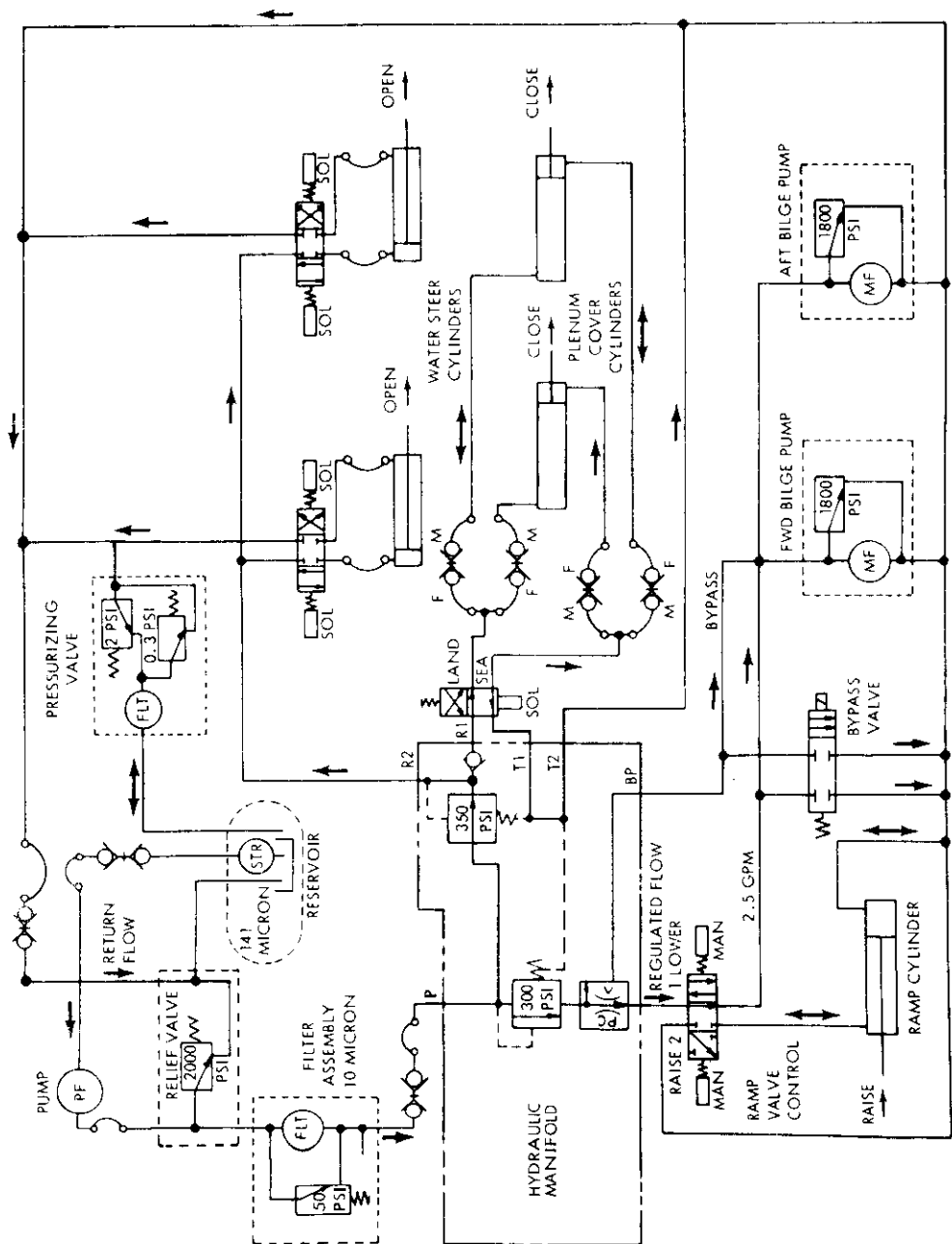


Figure 8-3. Sample of Electrical/Mechanical First Level
Functional Description Diagram

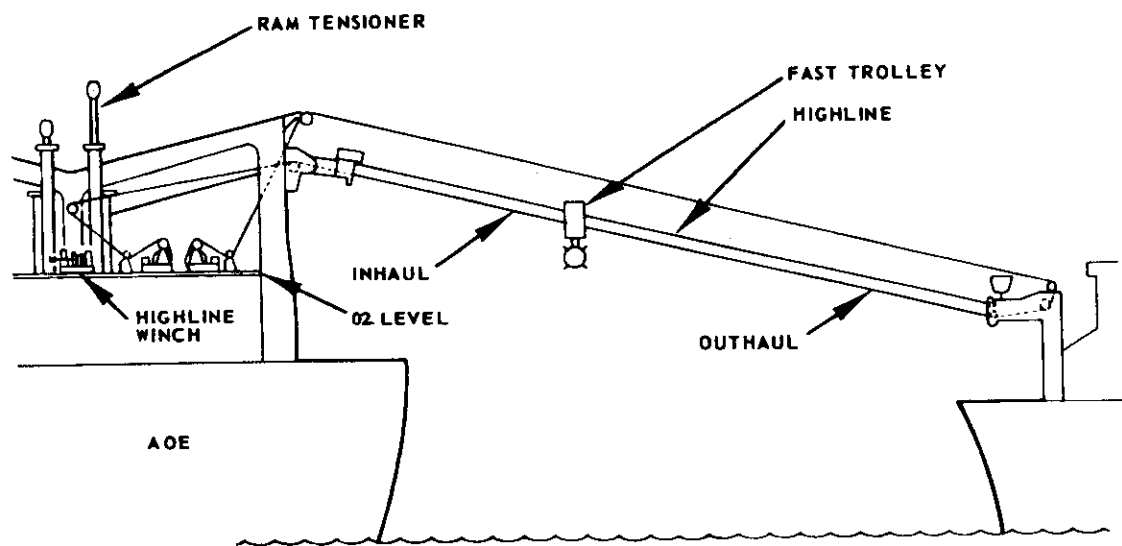


Figure 8-4. Sample of Second Level Functional Description Diagram
for Electrical/Mechanical System

Table 3-1. Operation-Based Symptom Fault Directory

Operating Procedure	Functional Description	Fault Isolation Procedure	Fault Isolation Diagram	Equipment Documentation
Option No. 1, Table 2-20 Transmit (VFCT-USB)	Para 2-4 Figure 2-37	Table 3-2	Figure 3-2	See Appendix A for individual equipment manuals. Use documentation as defined on the tables and figures in this chapter as applicable.
Option No. 1, Table 2-20 Receive (VFCT-USB)	Para 2-4 Figure 2-37	Table 3-3	Figure 3-3	
Option No. 2, Table 2-20 Transmit (VFCT-USB)	Para 2-4 Figure 2-38	Table 3-2	Figure 3-2	
Option No. 2, Table 2-20 Receive (VFCT-USB)	Para 2-4 Figure 2-38	Table 3-3	Figure 3-3	
Option No. 2, Table 2-20 Transmit (FSK) (RATT)- USB)	Para 2-4 Figure 2-39	Table 3-4	Figure 3-4	
Option No. 3, Table 2-20 Receive (FSK) (RATT)- USB)	Para 2-4 Figure 2-39	Table 3-5	Figure 3-5	
Option No. 4, Table 2-20 Transmit (FSK (RATT)- USB)	Para 2-4 Figure 2-40	Table 3-4	Figure 3-4	
Option No. 4, Table 2-20 Receive (FSK) (RATT)- USB)	Para 2-4 Figure 2-40	Table 3-5	Figure 3-5	
Option No. 5, Table 2-20 Transmit (FSK-USB, VOICE-LSB)	Para 2-4 Figure 2-41	Table 3-6	Figure 3-6	
Option No. 5, Table 2-20 Receive (FSK-USB, VOICE-LSB)	Para 2-4 Figure 2-41	Table 3-7	Figure 3-7	
Option No. 6 and No. 7 Table 2-20 Transmit (VOICE- USB, CW)	Para 2-4 Figure 2-42 and 2-43	Table 3-8	Figure 3-8	
Option No. 6 and No. 7 Table 2-20, (VOICE USB, CW)	Para 2-4 Figure 2-42 and 2-43	Table 3-8	Figure 3-8	

Figure 8-5. Sample of Operation-Based Symptom Fault Directory

PART IX. TECHNICAL CONTENT -10 THROUGH -40 MANUALS
TECHNICAL CONTENT -10 OPERATOR'S MANUAL

The -10 manual describes equipment operation and the maintenance to be performed by the operator/crew (1st echelon).

Arrange the technical contents of the manual as follows:

9-1. CHAPTER HEADINGS

- a. Chapter 1. General Information and Safety Precautions
- b. Chapter 2. Operating Instructions
- c. Chapter 3. Scheduled Maintenance
- d. Appendix A. Related Technical Information and Procedures (exclusive of administrative procedures).

Chapter 1. General Information and Safety Precautions

**9-2. CHAPTER 1.
GENERAL
INFORMATION
AND SAFETY
PRECAUTIONS**

Divide this chapter into two sections as follows:

- a. Section I. Introduction
- b. Section II. Equipment Description.

Provide an explanation of the purpose, scope, supersedure data, and applicability of the technical manual. Include, as well, the models, serial numbers, and configurations covered. State the interface relationship of the technical manual to other referenced publications. State the relationship of the equipment to referenced systems or other equipment. Include warranty/guarantee information, as applicable. Also include or cross-reference all safety precautions necessary for the protection of personnel and equipment.

**9-3. SECTION I.
INTRODUCTION**

**9-4. SECTION II.
EQUIPMENT
DESCRIPTION**

Describe the intended use, capabilities, and limitations of the equipment. Make text covering physical description or structural arrangements brief. Avoid unnecessary or repetitious details that are easily illustrated. Clearly show and identify the equipment and all of its units. If the technical manual covers more than one equipment configuration, provide a table defining the differences. The equipment description must include the following information:

**9-4.a. Equipment
Illustration**

- a. Equipment Illustration. Include an illustration representing all units comprising the equipment (see figure 5-1). Make the illustration a left-hand full page or foldout page (never backed up). In the illustration, show the:

- (1) Major units of the equipment
- (2) Relative size of each unit
- (3) Basic interconnections between units
- (4) Relationship of units with other equipment.

9-4.b. Reference Data

- b. Reference Data. Include the following data in tabular form:

- (1) Descriptive (nameplate data). State equipment manufacturer, type, model, and Marine Corps identification number, as applicable.
- (2) Functional. State such characteristics as power requirements, horsepower, pressure, capacity, modes of operation, power output, frequency, pulse, sensitivity, selectivity, and applicable tolerances.
- (3) Capabilities and Limitations. State such information as pounds of thrust, miles per hour, turning radius, minimum and maximum ranges, degrees of coverage, resolution and accuracy, as applicable.

- (4) Rated Outputs. State such information as wattages, voltages, horsepower and gallons per minute, as applicable.
- (5) Environmental. State such characteristics as: ambient temperatures, heat dissipation per unit, and humidity limits.

c. Equipment, Accessories, and Documents Supplied.

Provide a tabular listing of the equipment, its units, and accessories (special tools, test equipment, miscellaneous parts, government furnished items and publications) which form a part of or are supplied with the equipment. Set up the table as follows:

- (1) Column 1, Quantity. State quantity of each unit and accessories supplied with the equipment.
- (2) Column 2, Item Name or Nomenclature. State official name or nomenclature (name and designation) of each component, unit or accessory.
- (3) Column 3, Marine Corps Identification Number. State this number for each equipment unit or accessory, as available.
- (4) Column 4, Overall Dimensions. State crated (if available) and uncrated height, width, and depth in inches (or inches and centimeters) of each unit or accessory.
- (5) Column 5, Weight and Volume. State crated (if available) and uncrated weight and volume in cubic feet of each unit and accessory.

Describe equipment, accessories, and related publications not furnished with the basic equipment that the manual covers, but which have an important relationship to it.

**9-4.c. Equipment,
Accessories, and
Documents Supplied**

**9-5. RELATED ITEMS
NOT SUPPLIED**

Provide enough detail to establish their physical and functional relationship to the basic equipment.

**9-6. CHAPTER 2.
OPERATING
INSTRUCTIONS**

Chapter 2. Operating Instructions

Divide this chapter into two sections as follows:

- a. Section I. Controls and Indicators
- b. Section II. Operating Procedures.

**9-7. SECTION I.
CONTROLS AND
INDICATORS**

Describe the operator's relationship to the equipment. Identify those units having controls and indicators that the operator must use for performance of duties. Support the introduction with illustrations and tables that identify and locate all operator controls and indicators. Include the following information in this section:

- a. Names of panel designations as marked on the equipment.
- b. Positions and operating functions for each control, and the normal operating condition of each indicator in each of the operating functions.
- c. Detailed illustrations to support the text. (See figure 5-10.)
- d. Operator's Controls and Indicators table (see figure 5-11) that references illustration in which figure appears, panel designation, item, and function.
- e. When operation requires more than one person, indicate designated position and function of each. Specify the relationship between controls and indicators, and position and function, for each operator.

**9-8. SECTION II.
OPERATING
PROCEDURES**

Provide the following information on operating procedures:

-
- | | |
|---|---|
| a. <u>Operator Turn-On.</u> Include all steps necessary to bring equipment from OFF through STANDBY condition to full operation. | 9-8.a. Operator Turn-On |
| b. <u>Modes of Operation.</u> State procedures for each mode of operation, e.g., manual, automatic, local, remote, etc. Describe the use and relative advantage of each mode of operation. | 9-8.b. Modes of Operation |
| c. <u>Operation Under Interfering Conditions.</u> Describe equipment anti-jamming and interference reduction features. Describe advantages of each feature and operating procedures to be followed in all possible situations. Include supporting illustrations (e.g., indicator displays, waveforms, etc.) that provide typical observations of jamming and interference for evaluation by the operator. | 9-8.c. Operation Under Interfering Conditions |
| d. <u>Operator Turn-Off.</u> Include all steps necessary to bring equipment from full operation through STANDBY to OFF condition. | 9-8.d. Operator Turn-Off |
| e. <u>Emergency Operation.</u> Cover operation of equipment during emergency conditions. (e.g., control failure, air failure, lube oil failure). Include emergency operation instructions. Provide a warning or caution to return the equipment to proper operation when the emergency is over. | 9-8.e. Emergency Operation |
| f. <u>Emergency Turn-Off.</u> Explain how to turn equipment off during an emergency (e.g., fire, water, smoke, hazard to personnel, loss of coolant, normal power, etc.). | 9-8.f. Emergency Turn-Off |
| g. <u>Method of Presentation.</u> Operating procedures shall be presented in tabular form and shall be in concise, simply-worded, step-by-step procedures and shall include the following: | 9-8.g. Method of Presentation |
| (1) A short explanation of the operation to be performed. | |

- (2) Initial safety requirements (actions, inspections, and reference to emergency turn-off procedures).
- (3) Connection of any accessory equipment not permanently connected.
- (4) Instructions for obtaining or confirming the presence of all critical inputs such as power, coolant, air, signal, air conditioning, etc.
- (5) Procedures for setting controls and making adjustments which must be accomplished by the operator prior to equipment turn-on.
- (6) Procedures for determining operational readiness and the acceptable indications expected from built-in indicators such as meters, lamps, gages, cathode ray tubes, and recorder readouts.
- (7) Milestones in the operational status of the equipment shall be identified and included by brief statements such as the "the generator is now in STANDBY."
- (8) Visual or aural observations which occur as a result of an operator action, such as boom lowering, sweep rotation, blower motor running, etc.
- (9) Procedures that can be hazardous to personnel or equipment shall be emphasized by WARNINGS or CAUTIONS placed immediately prior to the specific step involving the possible hazard. "Notes" shall not be used.
- (10) Illustrative material supporting the procedures shall identify and locate all operating controls and indicating devices as well as normal in-use positions or indications.

- (11) Operator's checks and adjustments in proper sequence.
- (12) Operator's maintenance actions and schedules.

Chapter 3. Scheduled Maintenance

This chapter contains scheduled maintenance procedures and performance tests to be done on a scheduled or condition monitoring basis. Divide chapter 3 into three sections, as follows:

- a. Section I. Introduction
- b. Section II. Tools and Equipment
- c. Section III. Scheduled Maintenance Services.

Section I explains the scope of the chapters and the kinds of services to be performed by the operator/crew. This level of maintenance involves such services as the proper care, use, operation, cleaning, spot painting, and lubrication of equipment.

Section II specifies the tools and equipment to be issued to the operator/maintenance crew. Provide illustrations showing the use of any tools or equipment used in a special way for adjustment or calibration. Include these illustrations at the point where the instruction is given.

Section III contains the Scheduled Maintenance Action Index. This index is used to specify scheduled maintenance procedures. Tabulate the index as follows (see figure 5-12):

- a. Column 1, Interval. Provide an alphanumeric list of all maintenance actions contained in the chapter. Use the following interval symbols, as

9-9. CHAPTER 3. SCHEDULED MAINTENANCE

9-10. SECTION I. INTRODUCTION

9-11. SECTION II. TOOLS AND EQUIPMENT

9-12. SECTION III. SCHEDULED MAINTENANCE SERVICES

9-12.a. Interval

appropriate, in the order of increasing interval, as follows:

<u>Interval</u>	<u>Symbols</u>
Hourly	H
Daily	D
Weekly	W
Monthly	M
Quarterly (3 months)	Q
Semiannually (6 months)	S
Annually (12 months)	A
Overhaul cycle	C
As specified (explain circumstances)	R ¹

¹Precede an R interval by a recommended calendar interval, e.g., daily as specified (DR), weekly as specified (WR), etc.

**9-12.b. Maintenance
Action**

b. Column 2, Maintenance Action. List the maintenance action which corresponds to the interval number in column 1.

9-12.c. Reference

c. Column 3, Reference. State the paragraph or table number of the maintenance procedure that corresponds to the maintenance action in column 2.

9-13. APPENDIX

Appendix

Include appendices as applicable to identify appropriate related technical information and procedures (exclusive of administrative procedures).

9-14. INDEX

Index

Prepare an alphabetical index when the number of paragraphs exceeds 100. See figure 5-35.

TECHNICAL CONTENT -12
OPERATION AND MAINTENANCE MANUAL

The -12 manual describes equipment operation and the maintenance to be performed by the operator and organizational maintenance personnel (1st and 2nd echelons).

Arrange the technical contents of the manual as follows:

- a. Chapter 1. General Information and Safety Precautions
- b. Chapter 2. Installation
- c. Chapter 3. Operating Instructions
- d. Chapter 4. Scheduled Maintenance
- e. Chapter 5. Troubleshooting
- f. Chapter 6. Corrective Maintenance
- g. Chapter 7. Repair Parts List (If Applicable)
- h. Appendix A. Related Technical Information and Procedures (exclusive of administrative procedures).

Chapter 1. General Information and Safety Precautions

Refer to paragraph 9-2.

Refer to paragraph 9-3.

Refer to paragraph 9-4.

Refer to paragraph 9-4.a.

**9-15. CHAPTER
HEADINGS**

**9-16. CHAPTER 1.
GENERAL
INFORMATION
AND SAFETY
PRECAUTIONS**

**9-17. SECTION I.
INTRODUCTION**

**9-18. SECTION II.
EQUIPMENT
DESCRIPTION**

**9-18.a. Equipment
Illustration**

9-18.b. Reference Data Refer to paragraph 9-4.b.

9-18.c. Equipment,
Accessories, and
Documents Supplied Refer to paragraph 9-4.c.

9-19. RELATED ITEMS
NOT SUPPLIED Refer to paragraph 9-5.

9-20. CHAPTER 2. **Chapter 2. Installation**
INSTALLATION

In this chapter, provide the information necessary for proper equipment installation. The illustrations are the principal means of conveying information. Text is supportive to the illustrations. This chapter covers the following topics:

- a. Site selection
- b. Reference publications
- c. Tools and materials required
- d. Unpacking and repacking
- e. Foundation preparation
- f. Input requirements
- g. Installation procedures
- h. Installation checkout.

9-21. SITE SELECTION Reference the appropriate installation drawings if they contain all necessary site information. Provide any additional information needed to supplement the drawings. This information may consist of technical factors possibly affecting equipment performance such as:

- a. Availability of power required
- b. Suitability of site for future expansion
- c. Clean line of site transmission patch
- d. Instructions for plotting terrain profiles

- e. Accessibility to the site
- f. Any other terrain or site factors.

Reference any general publications required to complete the installation, if it is impractical to include that information in the text.

**9-22. REFERENCE
PUBLICATIONS**

Include information supplemental to the summary list of material. If no supplemental text information installation is required, reference the installation drawings by figure number.

**9-23. TOOLS AND
MATERIALS
REQUIRED**

Include information supplemental to the installation drawings regarding unpacking and repacking. Provide step-by-step procedures to prevent damage to the equipment or injury to personnel. Include supporting illustrations to clarify procedures. When packing for reshipment is required, include step-by-step procedures and illustrations. When packing is simply the reverse of unpacking, this fact need only be stated. Provide any special environmental conditions required for storage. Include instructions for items in the following categories:

**9-24. UNPACKING AND
REPACKING**

- a. Depreservation procedures required at the time of installation.
- b. Represervation packaging required prior to repacking for storage or shipment.
- c. Intricate mounting, blocking, or bracing.
- d. Special cushion inserts.
- e. Repairable items.
- f. Sensitive or fragile components.
- g. Items held in special cradles.
- h. Items furnished in reusable containers.
- i. Special environmental conditions required for storage.

- j. Special handling procedures required.
- k. Container storage or disposition instructions, as applicable.

**9-25. FOUNDATION
PREPARATION**

Include information supplemental to the installation drawings. If all foundation preparation information is contained on the installation drawings, reference the drawings by figure number.

**9-26. INPUT
REQUIREMENTS**

Summarize the input data contained on the installation drawings. State the parameters with tolerances for each of the inputs listed. Examples of inputs are as follows:

- a. Power
- b. Ventilation
- c. Dry air (waveguide pressure)
- d. Gyro information
- e. Fluid cooling
- f. Steam
- g. Freon.

**9-27. INSTALLATION
PROCEDURES**

Include the following types of supplemental information in the text, if not provided on the installation drawings:

- a. Instructions required to assemble units.
- b. Instructions required to mount units. Include bolting and bracing diagrams and data on shock mounts.
- c. Instructions for making electrical, plumbing, transmission line, and all other interface connections (external) to the equipment.
- d. Instructions for interconnecting units comprising the equipment.
- e. Servicing procedures, such as initial lubrication.
- f. Instructions for bonding and grounding.

Provide step-by-step procedures to demonstrate that the equipment operates correctly and within tolerances. Use a three-phase approach to structure the explanation:

- a. Phase 1, Installation, Inspection and Pre-Energizing Procedures. Provide inspection procedures, in the form of checklists, to ensure that:

- (1) All units of the equipment and required auxiliary equipment have been installed. Check to see that their location and orientation is proper, and that all cables, antennas, waveguides, transmission lines, dehydrators, coolant lines, piping, etc., have been installed in accordance with plans and specifications. Be sure that continuity exists in all interconnections.
- (2) The required test equipment is available, operating satisfactorily, and has been calibrated.
- (3) All field changes and mandatory retrofits have been accomplished.
- (4) All rotating devices are free from obstruction.
- (5) There is access to the equipment for maintenance.
- (6) It is safe to turn on the equipment.

- b. Phase 2, Initial Turn-On and Preliminary Tests. Include procedures for energizing the equipment for the first time. Applicable portions of Chapter 3 may be referenced. Include step-by-step procedures for testing the equipment electrical supply circuits including distribution panels,

9-28. INSTALLATION CHECKOUT

9-28.a. Phase 1. Installation, Inspection and Pre-Energizing Procedures

9-28.b. Phase 2. Initial Turn-On and Preliminary Tests

switches, breakers, relief valves, and interlocks. Include procedures for testing piping, electrical cables, wire rope, and stays. Also give procedures for proper installation of transmission lines and waveguides, hangar spacing, torquing of connectors, pressure testing, flow rates, standing wave ratio, attenuation checks, etc.

9-28.c. Phase 3.

Installation

Verification Tests

- c. Phase 3, Installation Verification Tests. Include complete instructions for testing the equipment in all modes of operation. Procedures must cover the checking of gauges, meters, alarms, and other sensing devices for proper operation and calibration. These tests must verify that all inputs are in tolerance. Where applicable, include voltage standing wave ratio (VSWR) and insertion loss tests to verify the proper installation of antenna-to-equipment waveguide runs. Include transducer impedance and source level checks to verify proper installation of transducers, domes, and cables. Include preliminary set-up data in each procedure. When a required alignment must be accomplished prior to performing a test, include or reference it in the procedure. Present test procedures in a logical order as follows:

- (1) Energize the equipment.
- (2) Test the first units (normally power supplies) which must be operating properly. When test results are within the required tolerance, reference the next logical test. Also reference the corrective maintenance or troubleshooting data to be used if test results are not within tolerance.

Chapter 3. Operating Instructions

Refer to paragraph 9-6.

Refer to paragraph 9-7.

Refer to paragraph 9-8.

Refer to paragraph 9-8.a.

Refer to paragraph 9-8.b.

Refer to paragraph 9-8.c.

Refer to paragraph 9-8.d.

Refer to paragraph 9-8.e.

Refer to paragraph 9-8.f.

Refer to paragraph 9-8.g.

Chapter 4. Scheduled Maintenance

Divide this chapter into three sections as follows:

- a. Section I - Introduction
- b. Section II - Tools and Equipment
- c. Section III - Scheduled Maintenance.

**9-29. CHAPTER 3.
OPERATING
INSTRUCTIONS****9-30. SECTION I.
CONTROLS AND
INDICATORS****9-31. SECTION II.
OPERATING
PROCEDURES****9-31.a. Operator Turn-On****9-31.b. Modes of
Operation****9-31.c. Operation Under
Interfering
Conditions****9-31.d. Operator Turn-Off****9-31.d. Emergency
Operation****9-31.f. Emergency Turn-
Off****9-31.g. Method of
Presentation****9-32. CHAPTER 4.
SCHEDULED
MAINTENANCE**

**9-33. SECTION I.
INTRODUCTION**

Section I explains the scope of the chapter and the kinds of services to be performed by organizational maintenance personnel. This level of maintenance involves such services as:

- a. Lubricating, cleaning, painting, and preserving of equipment
- b. Making minor adjustments
- c. Diagnosis and isolation of malfunctions
- d. Replacement of major assemblies that are easily accessible and do not require critical adjustments.

**9-34. SECTION II.
TOOLS AND
EQUIPMENT**

Section II specifies the tools and equipment to be issued to the applicable personnel. Provide illustrations showing the use of any tools or equipment used in a special way for adjustment or calibration. Include these illustrations at the point where the instruction is given.

**9-35. SECTION III.
SCHEDULED
MAINTENANCE**

Section III contains scheduled maintenance procedures in the form of maintenance check-off and performance standards. Coordinate with the Procuring Activity in preparing this information for the technical manual. Format this information, as follows:

**9-35.a. Scheduled
Maintenance
Action Index**

- a. Scheduled Maintenance Action Index. This index is used to specify scheduled performance tests and scheduled maintenance procedures. Tabulate the index as follows (see figure 5-12):

- (1) Column 1, Interval. Provide an alphanumeric list of all maintenance actions contained in the chapter. Use the following interval symbols, as appropriate, in the order of increasing interval, as listed below:

<u>Interval</u>	<u>Symbols</u>
Hourly	H
Daily	D
Weekly	W
Monthly	M
Quarterly (3 months)	Q
Semiannually (6 months)	S
Annually (12 months)	A
Overhaul cycle	C
As specified (explain circumstances)	R ¹

¹Precede an R interval by a recommended calendar interval, e.g., daily as specified (DR), weekly as specified (WR), etc.

- (2) Column 2, Maintenance Action. List the maintenance action which corresponds to the interval number in column 1.
- (3) Column 3, Reference. State the paragraph or table number of the maintenance procedure that corresponds to the maintenance action in column 2.

b. Scheduled Maintenance Procedures. Include the information required to inspect, clean, and lubricate the equipment. State the following, as applicable:

- (1) Safety precautions.
- (2) Tools, parts, materials, and test equipment required.
- (3) Cleaning solvents. Use government specification numbers and federal stock numbers to identify.

**9-35.b. Scheduled
Maintenance
Procedures**

- (4) Instructions for properly maintaining all safety devices and interlocks, with warnings and cautions.
- (5) Instructions for lubrication at operating temperatures, and types and quantities of lubricants to be applied. Use government specification numbers and federal stock numbers to identify lubricants. Include specific lubricants for arctic or tropic environments. When a proprietary lubricant is approved, list a government specification lubricant as an emergency substitute.
- (6) Procedures for obtaining access to subassemblies or subcomponents.
- (7) Instructions for in-place balancing and noise reduction.
- (8) Inspection procedures for parts which deteriorate due to cycles of use, age, or climatic conditions.
- (9) Illustrations to identify lubrication points and other pertinent data.
- (10) Other information pertinent to these procedures.

**9-35.c. Scheduled
Performance
Tests**

- c. Scheduled Performance Tests. Provide step-by-step procedures necessary to verify that the equipment is operating within standards in all modes of operation. Include the following:

- (1) Safety precautions.
- (2) List of tools and test equipment identified by type, manufacturer, and model number.
- (3) Title of the test to be performed.
- (4) Preliminary set-up data required to perform the test.

- (5) Detailed procedures for accomplishing the test. Procedures requiring lengthy and identical set-up data may be presented in detail in one procedure and referenced in succeeding procedures.
- (6) Values or conditions, with tolerances, indicative of normal operation.

Chapter 5. Troubleshooting

Chapter 5 contains the instructions and information necessary to locate equipment malfunctions and to conduct tests on equipment. Provide a troubleshooting table for logical isolation of faults. List step-by-step procedures for troubleshooting. Support the table and text with diagrams and illustrations, as necessary. Format the table to show malfunction, probable cause, and possible remedy (see figure 5-13).

Chapter 6. Corrective Maintenance

This chapter contains instructions required to adjust and align the equipment, and to remove, repair, reinstall, and align all repairable parts, modules, subassemblies, and assemblies. The instructions must identify the actions to be accomplished; safety precautions to be observed; and tools, parts, materials, and test equipment required. They must also identify preliminary control settings, test equipment, setup instructions, and step-by-step instructions, with supporting illustrations, to accomplish the maintenance task. Provide corrective maintenance instructions for all items designated repairable, irrespective of the maintenance concept, unless this information is included in another technical manual and can be referenced. Divide this chapter into three sections as follows:

9-36. CHAPTER 5. TROUBLE- SHOOTING

9-37. CHAPTER 6. CORRECTIVE MAINTENANCE

- a. Section I. Introduction
- b. Section II. Adjustments and Alignments
- c. Section III. Repair.

**9-38. SECTION I.
INTRODUCTION**

Explain the purpose, scope, and arrangement of the corrective maintenance data.

**9-39. SECTION II.
ADJUSTMENTS
AND
ALIGNMENTS**

Provide all information and procedures required to perform all necessary adjustments and alignments as follows:

- a. Non-operator type adjustments
- b. Alignments requiring external jigs, test equipment, or bench setups
- c. Alignments that are accomplished after a repair or replacement of a part or module
- d. Test equipment setup and other illustrations necessary to support the procedures.

**9-40. SECTION III.
REPAIR**

State all procedures required in the repair of assemblies and repairable parts. Repair procedures include but are not limited to the following:

- a. Removal, disassembly, and inspection
- b. Repair or replacement of piece parts
- c. Cleaning, reassembly, adjustment, installation, calibration, and checkout
- d. Exploded views, sectional views, wiring diagrams, and photographs necessary to support the procedures
- e. Do not include obvious repair actions such as soldering, use of multimeters, hand tools, etc., unless those actions involve hazards to personnel or equipment
- f. Arrange repair procedures in numeric-alpha unit designation order of the equipment.

Use clear, sharp illustrations to supplement description and maintenance coverage. Use exploded views for parts location illustration. As a minimum, include illustrations or sketches of the following, when applicable:

- a. Typical bearings for rotating or moving equipment.
- b. Method of taking clearance measurements.
- c. Typical mechanism for absorbing thrust.
- d. Locking devices.
- e. Typical seal assembly (pressure and/or vacuum seals or controlled leakage between rotor and casing).
- f. Typical assembly of blading to rotor, with lock devices.
- g. Typical assembly of field poles, laminated core iron, electrical windings, commutators, slip rings, and brush rigging.
- h. Equipment assembly with upper casing partially removed.
- i. Series of illustrations showing illustration of supervisory instruments.

Chapter 7. Repair Parts List (If Applicable)

Refer to paragraph 5-34.

Refer to paragraph 5-35.

9-41. SUPPORTING ILLUSTRATIONS AND DATA

9-42. CHAPTER 7. REPAIR PARTS LIST (IF APPLICABLE)

9-43. SECTION I. ITEM IDENTIFICATION LISTING

9-43.a. Item Number	Refer to paragraph 5-35.a.
9-43.b. Model	Refer to paragraph 5-35.b.
9-43.c. Stock Number	Refer to paragraph 5-35.c.
9-43.d. Reference Designator	Refer to paragraph 5-35.d.
9-43.e. Indenture Code	Refer to paragraph 5-35.e.
9-43.f. Item Identification	Refer to paragraph 5-35.f.
9-43.g. Unit of Measure	Refer to paragraph 5-35.g.
9-43.h. Quantity	Refer to paragraph 5-35.h.
9-43.i. Source Maintenance Recoverability Code	Refer to paragraph 5-35.i.
9-43.j. Special Stockage Indicator Code	Refer to paragraph 5-35.j.
9-43.k. Replacement Factor	Refer to paragraph 5-35.k.
9-44. SECTION II. ITEM NUMBER CROSS-REFERENCE	Refer to paragraph 5-36.
9-45. SECTION III. NATIONAL STOCK NUMBER CROSS- REFERENCE	Refer to paragraph 5-37.
9-46. SECTION IV. PART NUMBER CROSS-REFERENCE	Refer to paragraph 5-38.
9-47. SECTION V. CIRCUIT SYMBOL NUMBER TO ITEM NUMBER CROSS-REFERENCE	Refer to paragraph 5-39.
9-48. ASSEMBLY/ SUBASSEMBLY ILLUSTRATIONS	Refer to paragraph 5-40.

Refer to paragraph 5-40.a.

Refer to paragraph 5-40.b.

Refer to paragraph 5-40.c.

Refer to paragraph 5-40.d.

9-48.a. Callouts

9-48.b. Exploded Views

**9-48.c. Line Drawings
and Photographs**

**9-48.d. Printed Circuit
Board**

Appendix

Include appendices, as applicable, to identify appropriate related technical information and procedures (exclusive of administrative procedures).

9-49. APPENDIX

Index

Prepare an alphabetical index when the number of paragraphs exceeds 100. (See figure 5-35.)

9-50. INDEX

TECHNICAL CONTENT -13 OPERATION AND MAINTENANCE MANUAL

The -13 manual describes equipment operation and the maintenance to be performed by the operator, organizational, and intermediate maintenance personnel (1st, 2nd and 3rd echelons).

Arrange the technical contents of the manual as follows:

9-51. CHAPTER HEADINGS

- a. Chapter 1. General Information and Safety Precautions
- b. Chapter 2. Installation
- c. Chapter 3. Operating Instructions
- d. Chapter 4. Scheduled Maintenance
- e. Chapter 5. Troubleshooting
- f. Chapter 6. Corrective Maintenance
- g. Chapter 7. Repair Parts List (If Applicable)
- h. Appendix A. Related Technical Information and Procedures (exclusive of administrative procedures).

Chapter 1. General Information and Safety Precautions

9-52. CHAPTER 1. GENERAL INFORMATION AND SAFETY PRECAUTIONS

Refer to paragraph 9-2.

Refer to paragraph 9-3.

9-53. SECTION I. INTRODUCTION

Refer to paragraph 9-4.

9-54. SECTION II. EQUIPMENT DESCRIPTION

9-54.a. Equipment Illustration	Refer to paragraph 9-4.a.
9-54.b. Reference Data	Refer to paragraph 9-4.b.
9-54.c. Equipment, Accessories, and Documents Supplied	Refer to paragraph 9-4.c.
9-55. RELATED ITEMS NOT SUPPLIED	Refer to paragraph 9-5.
9-56. CHAPTER 2. INSTALLATION	Chapter 2. Installation
	Refer to paragraph 9-20.
9-57. SITE SELECTION	Refer to paragraph 9-21.
9-58. REFERENCE PUBLICATIONS	Refer to paragraph 9-22.
9-59. TOOLS AND MATERIALS REQUIRED	Refer to paragraph 9-23.
9-60. UNPACKING AND REPACKING	Refer to paragraph 9-24.
9-61. FOUNDATION PREPARATION	Refer to paragraph 9-25.
9-62. INPUT REQUIREMENTS	Refer to paragraph 9-26.
9-63. INSTALLATION PROCEDURES	Refer to paragraph 9-27.

Refer to paragraph 9-28.

**9-64. INSTALLATION
CHECKOUT**

Refer to paragraph 9-28.a.

**9-64.a. Phase 1.
Installation,
Inspection and
Pre-Energizing
Procedures**

Refer to paragraph 9-28.b.

**9-64.b. Phase 2.
Initial Turn-On and
Preliminary Tests**

Refer to paragraph 9-28.c.

**9-64.c. Phase 3.
Installation
Verification
Tests**

Chapter 3. Operating Instructions

**9-65. CHAPTER 3.
OPERATING
INSTRUCTIONS**

Refer to paragraph 9-6.

**9-66. SECTION I.
CONTROLS AND
INDICATORS**

Refer to paragraph 9-7.

**9-67. SECTION II.
OPERATING
PROCEDURES**

Refer to paragraph 9-8.

9-67.a. Operator Turn-On

Refer to paragraph 9-8.a.

**9-67.b. Modes of
Operation**

Refer to paragraph 9-8.b.

**9-67.c. Operation Under
Interfering
Conditions**

Refer to paragraph 9-8.c.

9-67.d. Operator Turn-Off

Refer to paragraph 9-8.d.

9-67.e. Emergency Operation Refer to paragraph 9-8.e.

9-67.f. Emergency Turn-Off Refer to paragraph 9-8.f.

9-67.g. Method of Presentation Refer to paragraph 9-8.g.

9-68. CHAPTER 4.
SCHEDULED
MAINTENANCE

Chapter 4. Scheduled Maintenance

Divide this chapter into three sections as follows:

- a. Section I - Introduction
- b. Section II - Tools and Equipment
- c. Section III - Scheduled Maintenance.

9-69. SECTION I.
INTRODUCTION

Section I explains the scope of the chapter and the kinds of services to be performed by 3rd echelon maintenance personnel. This level of maintenance involves such services as:

- a. Diagnosis and isolation of malfunctions.
- b. Replacement of defective parts.
- c. Replacement of modular components such as the cleaning and replacement of seals, fittings, and other external replaceable parts.
- d. Performance of pollution evaluation emissions, performance of light body repairs.
- e. Evacuation of unserviceable end items.
- f. Technical support to lower echelons of maintenance.
- g. Mobile repair crews and repair parts to lower echelons of maintenance, as necessary.

Section II specifies the tools and equipment to be issued to 3rd echelon maintenance personnel. List electronic test equipment by Joint Army-Navy (JAN) nomenclature. List other items by the proper Cataloging Handbook nomenclature. Provide illustrations showing the use of any tools or equipment used in a special way for adjustment or calibration. Include these illustrations at the point where the instruction is given.

**9-70. SECTION II.
TOOLS AND
EQUIPMENT**

Section III contains scheduled maintenance procedures in the form of maintenance check-off and performance standards. Coordinate with the Procuring Activity in preparing this information for the technical manual. Format this information, as follows:

**9-71. SECTION III.
SCHEDULED
MAINTENANCE**

- a. Scheduled Maintenance Action Index. This index is used to specify scheduled performance tests and scheduled maintenance procedures. Tabulate the index as follows (see figure 5-12):

**9-71.a. Scheduled
Maintenance
Action Index**

- (1) Column 1, Interval. Provide an alphanumeric list of all maintenance actions contained in the chapter. Use the following interval symbols, as appropriate, in the order of increasing interval, listed as follows:

<u>Interval</u>	<u>Symbols</u>
Hourly	H
Daily	D
Weekly	W
Monthly	M
Quarterly (3 months)	Q
Semiannually (6 months)	S
Annually (12 months)	A
Overhaul cycle	C
As specified (explain circumstances)	R ¹

¹Precede an R interval by a recommended calendar interval, e.g., daily as specified (DR), weekly as specified (WR), etc.

- (2) Column 2, Maintenance Action. List the maintenance action which corresponds to the interval number in column 1.
- (3) Column 3, Reference. State the paragraph or table number of the maintenance procedure that corresponds to the maintenance action in column 2.

**9-71.b. Scheduled
Maintenance
Procedures**

- b. Scheduled Maintenance Procedures. Include the information required to inspect, clean, and lubricate the equipment. State the following, as applicable:

- (1) Safety precautions.
- (2) Tools, parts, materials, and test equipment required.
- (3) Cleaning solvents. Use government specification numbers and federal stock numbers to identify.

Refer to paragraph 5-35.

**9-79. SECTION I.
ITEM IDENTIFI-
CATION LISTING**

Refer to paragraph 5-35.a.

9-79.a. Item Number

Refer to paragraph 5-35.b.

9-79.b. Model

Refer to paragraph 5-35.c.

9-79.c. Stock Number

Refer to paragraph 5-35.d.

**9-79.d. Reference
Designator**

Refer to paragraph 5-35.e.

**9-79.e. Indenture
Code**

Refer to paragraph 5-35.f.

**9-79.f. Item
Identification**

Refer to paragraph 5-35.g.

**9-79.g. Unit of
Measure**

Refer to paragraph 5-35.h.

9-79.h. Quantity

Refer to paragraph 5-35.i.

**9-79.i. Source
Maintenance
Recoverability
Code**

Refer to paragraph 5-35.j.

**9-79.j. Special Stockage
Indicator Code**

Refer to paragraph 5-35.k.

**9-79.k. Replacement
Factor**

Refer to paragraph 5-36.

**9-80. SECTION II.
ITEM NUMBER
CROSS-REFERENCE**

Refer to paragraph 5-37.

**9-81. SECTION III.
NATIONAL
STOCK NUMBER
CROSS-REFERENCE**

9-82. SECTION IV. Refer to paragraph 5-38.
PART NUMBER
CROSS-REFERENCE

9-83. SECTION V. Refer to paragraph 5-39.
CIRCUIT SYMBOL
NUMBER TO ITEM
NUMBER CROSS-REFERENCE

9-84. ASSEMBLY/ Refer to paragraph 5-40.
SUBASSEMBLY
ILLUSTRATIONS

9-84.a. Callouts Refer to paragraph 5-40.a.

9-84.b. Exploded Views Refer to paragraph 5-40.b.

9-84.c. Line Drawings Refer to paragraph 5-40.c.
and Photographs

9-84.d. Printed Circuit Refer to paragraph 5-40.d.
Board

9-85. APPENDIX **Appendix**

Include appendices, as applicable, to identify appropriate related technical information and procedures (exclusive of administrative procedures).

9-86. INDEX **Index**

Prepare an alphabetical index when the number of paragraphs exceeds 100. (See figure 5-35.)

- (4) Instructions for properly maintaining all safety devices and interlocks, with warnings and cautions.
- (5) Instructions for lubrication at operating temperatures, and types and quantities of lubricants to be applied. Use government specification numbers and federal stock numbers to identify lubricants. Include specific lubricants for arctic or tropic environments. When a proprietary lubricant is approved, list a government specification lubricant as an emergency substitute.
- (6) Procedures for obtaining access to subassemblies or subcomponents.
- (7) Instructions for in-place balancing and noise reduction.
- (8) Inspection procedures for parts which deteriorate due to cycles of use, age, or climatic conditions.
- (9) Illustrations to identify lubrication points and other pertinent data.
- (10) Other information pertinent to these procedures.

c. Scheduled Performance Tests. Provide step-by-step procedures necessary to verify that the equipment is operating within standards in all modes of operation. Include the following:

- (1) Safety precautions.
- (2) List of tools and test equipment identified by type, manufacturer, and model number.
- (3) Title of the test to be performed.
- (4) Preliminary set-up data required to perform the test.

**9-71.c. Scheduled
Performance
Tests**

(5) Detailed procedures for accomplishing the test. Procedures requiring lengthy and identical set-up data may be presented in detail in one procedure and referenced in succeeding procedures.

(6) Values or conditions, with tolerances, indicative of normal operation.

**9-72. CHAPTER 5.
TROUBLE-
SHOOTING**

Chapter 5. Troubleshooting

Refer to paragraph 9-36.

**9-73. CHAPTER 6.
CORRECTIVE
MAINTENANCE**

Chapter 6. Corrective Maintenance

Refer to paragraph 9-37.

**9-74. SECTION I.
INTRODUCTION**

Refer to paragraph 9-38.

**9-75. SECTION II.
ADJUSTMENTS AND
ALIGNMENTS**

Refer to paragraph 9-39.

**9-76. SECTION III.
REPAIR**

Refer to paragraph 9-40.

**9-77. SUPPORTING
ILLUSTRATIONS
AND DATA**

Refer to paragraph 9-41.

**9-78. CHAPTER 7.
REPAIR PARTS
LIST (IF
APPLICABLE)**

Chapter 7. Repair Parts List (If Applicable)

Refer to paragraph 5-34.

TECHNICAL CONTENT -14 OPERATION AND MAINTENANCE MANUAL

The -14 manual describes equipment operation and the maintenance to be performed by the operator, organizational, intermediate maintenance personnel (1st through 4th echelons).

Arrange the technical contents of the manual as follows:

**9-87. CHAPTER
HEADINGS**

- a. Chapter 1. General Information and Safety Precautions
- b. Chapter 2. Installation
- c. Chapter 3. Operating Instructions
- d. Chapter 4. Scheduled Maintenance
- e. Chapter 5. Troubleshooting
- f. Chapter 6. Corrective Maintenance
- g. Chapter 7. Repair Parts List (If Applicable)
- h. Appendix A. Related Technical Information and Procedures (exclusive of administrative procedures).

Chapter 1. General Information and Safety Precautions

**9-88. CHAPTER 1.
GENERAL
INFORMATION
AND SAFETY
PRECAUTIONS**

Refer to paragraph 9-2.

Refer to paragraph 9-3.

**9-89. SECTION I.
INTRODUCTION**

Refer to paragraph 9-4.

**9-90. SECTION II.
EQUIPMENT
DESCRIPTION**

9-90.a. Equipment Illustration	Refer to paragraph 9-4.a.
9-90.b. Reference Data	Refer to paragraph 9-4.b.
9-90.c. Equipment, Accessories, and Documents Supplied	Refer to paragraph 9-4.c.
9-91. RELATED ITEMS NOT SUPPLIED	Refer to paragraph 9-5.
9-92. CHAPTER 2. INSTALLATION	Chapter 2. Installation
	Refer to paragraph 9-20.
9-93. SITE SELECTION	Refer to paragraph 9-21.
9-94. REFERENCE PUBLICATIONS	Refer to paragraph 9-22.
9-95. TOOLS AND MATERIALS REQUIRED	Refer to paragraph 9-23.
9-96. UNPACKING AND REPACKING	Refer to paragraph 9-24.
9-97. FOUNDATION PREPARATION	Refer to paragraph 9-25.
9-98. INPUT REQUIREMENTS	Refer to paragraph 9-26.
9-99. INSTALLATION PROCEDURES	Refer to paragraph 9-27.

Refer to paragraph 9-28.

**9-100. INSTALLATION
CHECKOUT**

Refer to paragraph 9-28.a.

**9-100.a. Phase 1.
Installation,
Inspection and
Pre-Energizing
Procedures**

Refer to paragraph 9-28.b.

**9-100.b. Phase 2.
Initial Turn-On and
Preliminary Tests**

Refer to paragraph 9-28.c.

**9-100.c. Phase 3.
Installation
Verification
Tests**

Chapter 3. Operating Instructions

**9-101. CHAPTER 3.
OPERATING
INSTRUCTIONS**

Refer to paragraph 9-6.

Refer to paragraph 9-7.

**9-102. SECTION I.
CONTROLS AND
INDICATORS**

Refer to paragraph 9-8.

**9-103. SECTION II.
OPERATING
PROCEDURES**

Refer to paragraph 9-8.a.

Refer to paragraph 9-8.b.

Refer to paragraph 9-8.c.

Refer to paragraph 9-8.d.

**9-103.a. Operator Turn-On
9-103.b. Modes of
Operation
9-103.c. Operation Under
Interfering
Conditions
9-103.d. Operator Turn-Off**

9-103.e. Emergency Operation Refer to paragraph 9-8.e.

9-103.f. Emergency Turn-Off Refer to paragraph 9-8.f.

9-103.g. Method of Presentation Refer to paragraph 9-8.g.

9-104. CHAPTER 4.
SCHEDULED
MAINTENANCE

Chapter 4. Scheduled Maintenance

Divide this chapter into three sections as follows:

- a. Section I - Introduction
- b. Section II - Tools and Equipment
- c. Section III - Scheduled Maintenance.

9-105. SECTION I.
INTRODUCTION

Section I explains the scope of the chapter and the kinds of services to be performed by 4th echelon maintenance personnel. This level of maintenance involves such services as:

- a. Diagnosis and isolation of malfunctions at the internal piece part level.
- b. Equipment adjustment, alignment, and repair to original manufacturer's tolerances and standards.
- c. Replacement of defective modular components beyond the authorized capability of lower maintenance echelons.
- d. Repair of modular components by grinding, adjusting, or aligning.
- e. Repair of modular components by replacing internal and external piece parts.
- f. Performance of heavy body hull, turret, and frame repair.

Section II specifies the tools and equipment to be issued to 4th echelon maintenance personnel. List electronic test equipment by Joint Army-Navy (JAN) nomenclature. List other items by the proper Cataloging Handbook nomenclature. Provide illustrations showing the use of any tools or equipment used in a special way for adjustment or calibration. Include these illustrations at the point where the instruction is given.

**9-106. SECTION II.
TOOLS AND
EQUIPMENT**

Section III contains scheduled maintenance procedures in the form of maintenance check-off and performance standards. Coordinate with the Procuring Activity in preparing this information for the technical manual. Format this information, as follows:

**9-107. SECTION III.
SCHEDULED
MAINTENANCE**

- a. Scheduled Maintenance Action Index. This index is used to specify scheduled performance tests and scheduled maintenance procedures. Tabulate the index as follows (see figure 5-12):

**9-107.a. Scheduled
Maintenance
Action Index**

- (1) Column 1, Interval. Provide an alphanumeric list of all maintenance actions contained in the chapter. Use the following interval symbols, as appropriate, in the order of increasing interval, as listed below:

<u>Interval</u>	<u>Symbols</u>
Hourly	H
Daily	D
Weekly	W
Monthly	M
Quarterly (3 months)	Q
Semiannually (6 months)	S
Annually (12 months)	A
Overhaul cycle	C
As specified (explain circumstances)	R ¹

¹Precede an R interval by a recommended calendar interval, e.g., daily as specified (DR), weekly as specified (WR), etc.

- (2) Column 2, Maintenance Action. List the maintenance action which corresponds to the interval number in column 1.
- (3) Column 3, Reference. State the paragraph or table number of the maintenance procedure that corresponds to the maintenance action in column 2.

**9-107.b. Scheduled
Maintenance
Procedures**

- b. Scheduled Maintenance Procedures. Include the information required to inspect, clean, and lubricate the equipment. State the following, as applicable:

- (1) Safety precautions.
- (2) Tools, parts, materials, and test equipment required.

- (3) Cleaning solvents. Use government specification numbers and federal stock numbers to identify.
- (4) Instructions for properly maintaining all safety devices and interlocks, with warnings and cautions.
- (5) Instructions for lubrication at operating temperatures, and types and quantities of lubricants to be applied. Use government specification numbers and federal stock numbers to identify lubricants. Include specific lubricants for arctic or tropic environments. When a proprietary lubricant is approved, list a government specification lubricant as an emergency substitute.
- (6) Procedures for obtaining access to subassemblies or subcomponents.
- (7) Instructions for in-place balancing and noise reduction.
- (8) Inspection procedures for parts which deteriorate due to cycles of use, age, or climatic conditions.
- (9) Illustrations to identify lubrication points and other pertinent data.
- (10) Other information pertinent to these procedures.

c. Scheduled Performance Tests. Provide step-by-step procedures necessary to verify that the equipment is operating within standards in all modes of operation. Include the following:

- (1) Safety precautions.
- (2) List of tools and test equipment identified by type, manufacturer, and model number.

**9-107.c. Scheduled
Performance
Tests**

- (3) Title of the test to be performed.
- (4) Preliminary set-up data required to perform the test.
- (5) Detailed procedures for accomplishing the test.
Procedures requiring lengthy and identical set-up data may be presented in detail in one procedure and referenced in succeeding procedures.
- (6) Values or conditions, with tolerances, indicative of normal operation.

**9-108. CHAPTER 5.
TROUBLE-
SHOOTING**

Chapter 5. Troubleshooting

Refer to paragraph 9-36.

**9-109. CHAPTER 6.
CORRECTIVE
MAINTENANCE**

Chapter 6. Corrective Maintenance

Refer to paragraph 9-37.

**9-110. SECTION I.
INTRODUCTION**

Refer to paragraph 9-38.

**9-111. SECTION II.
ADJUSTMENTS AND
ALIGNMENTS**

Refer to paragraph 9-39.

**9-112. SECTION III.
REPAIR**

Refer to paragraph 9-40.

**9-113. SUPPORTING
ILLUSTRATIONS
AND DATA**

Refer to paragraph 9-41.

**9-114. CHAPTER 7.
REPAIR PARTS
LIST (IF
APPLICABLE)**

Chapter 7. Repair Parts List (If Applicable)

Refer to paragraph 5-34.

Refer to paragraph 5-35.

**9-115. SECTION I.
ITEM IDENTIFI-
CATION LISTING**

Refer to paragraph 5-35.a.

9-115.a. Item Number

Refer to paragraph 5-35.b.

9-115.b. Model

Refer to paragraph 5-35.c.

9-115.c. Stock Number

Refer to paragraph 5-35.d.

**9-115.d. Reference
Designator**

Refer to paragraph 5-35.e.

**9-115.e. Indenture
Code**

Refer to paragraph 5-35.f.

**9-115.f. Item
Identification**

Refer to paragraph 5-35.g.

**9-115.g. Unit of
Measure**

Refer to paragraph 5-35.h.

9-115.h. Quantity

Refer to paragraph 5-35.i.

**9-115.i. Source
Maintenance
Recoverability
Code**

Refer to paragraph 5-35.j.

**9-115.j. Special Stockage
Indicator Code**

Refer to paragraph 5-35.k.

**9-115.k. Replacement
Factor**

Refer to paragraph 5-36.

**9-116. SECTION II.
ITEM NUMBER
CROSS-REFERENCE**

Refer to paragraph 5-37.

**9-117. SECTION III.
NATIONAL
STOCK NUMBER
CROSS-REFERENCE**

9-118. SECTION IV. Refer to paragraph 5-38.
PART NUMBER
CROSS-REFERENCE

9-119. SECTION V. Refer to paragraph 5-39.
CIRCUIT SYMBOL
NUMBER TO ITEM
NUMBER CROSS-REFERENCE

9-120. ASSEMBLY/ Refer to paragraph 5-40.
SUBASSEMBLY
ILLUSTRATIONS

9-120.a. Callouts Refer to paragraph 5-40.a.

9-120.b. Exploded Views Refer to paragraph 5-40.b.

9-120.c. Line Drawings Refer to paragraph 5-40.c.
and Photographs

9-120.d. Printed Circuit Refer to paragraph 5-40.d.
Board

9-121. APPENDIX **Appendix**

Include appendices, as applicable, to identify appropriate related technical information and procedures (exclusive of administrative procedures).

9-122. INDEX **Index**

Prepare an alphabetical index when the number of paragraphs exceeds 100. (See figure 5-35.)

TECHNICAL CONTENT -15 OPERATION AND MAINTENANCE MANUAL

The -15 manual describes equipment operation and the maintenance to be performed by the operator, organizational, intermediate, and depot maintenance personnel (1st through 5th echelons).

Arrange the technical contents of the manual as follows:

- a. Chapter 1. General Information and Safety Precautions
- b. Chapter 2. Installation
- c. Chapter 3. Operating Instructions
- d. Chapter 4. Scheduled Maintenance
- e. Chapter 5. Troubleshooting
- f. Chapter 6. Corrective Maintenance (Less Depot)
- g. Chapter 7. Depot Maintenance/Overhaul Instructions
- h. Chapter 8. Repair Parts List (If Applicable)
- i. Appendix A. Related Technical Information and Procedures (exclusive of administrative procedures).

Chapter 1. General Information and Safety Precautions

Refer to paragraph 9-2.

Refer to paragraph 9-3.

Refer to paragraph 9-4.

9-123. CHAPTER HEADINGS

9-124. CHAPTER 1. GENERAL INFORMATION AND SAFETY PRECAUTIONS

9-125. SECTION I. INTRODUCTION

9-126. SECTION II. EQUIPMENT DESCRIPTION

9-126.a. Equipment Illustration	Refer to paragraph 9-4.a.
9-126.b. Reference Data	Refer to paragraph 9-4.b.
9-126.c. Equipment, Accessories, and Documents Supplied	Refer to paragraph 9-4.c.
9-127. RELATED ITEMS NOT SUPPLIED	Refer to paragraph 9-5.
9-128. CHAPTER 2. INSTALLATION	Chapter 2. Installation
	Refer to paragraph 9-20.
9-129. SITE SELECTION	Refer to paragraph 9-21.
9-130. REFERENCE PUBLICATIONS	Refer to paragraph 9-22.
9-131. TOOLS AND MATERIALS REQUIRED	Refer to paragraph 9-23.
9-132. UNPACKING AND REPACKING	Refer to paragraph 9-24.
9-133. FOUNDATION PREPARATION	Refer to paragraph 9-25.
9-134. INPUT REQUIREMENTS	Refer to paragraph 9-26.
9-135. INSTALLATION PROCEDURES	Refer to paragraph 9-27.

Refer to paragraph 9-28.

**9-136. INSTALLATION
CHECKOUT**

Refer to paragraph 9-28.a.

**9-136.a. Phase 1.
Installation,
Inspection and
Pre-Energizing
Procedures**

Refer to paragraph 9-28.b.

**9-136.b. Phase 2.
Initial Turn-On and
Preliminary Tests**

Refer to paragraph 9-28.c.

**9-136.c. Phase 3.
Installation
Verification
Tests**

Chapter 3. Operating Instructions

**9-137. CHAPTER 3.
OPERATING
INSTRUCTIONS**

Refer to paragraph 9-6.

Refer to paragraph 9-7.

**9-138. SECTION I.
CONTROLS AND
INDICATORS**

Refer to paragraph 9-8.

**9-139. SECTION II.
OPERATING
PROCEDURES**

Refer to paragraph 9-8.a.

9-139.a. Operator Turn-On

Refer to paragraph 9-8.b.

**9-139.b. Modes of
Operation**

Refer to paragraph 9-8.c.

**9-139.c. Operation Under
Interfering
Conditions**

Refer to paragraph 9-8.d.

9-139.d. Operator Turn-Off

9-139.e. Emergency Operation

Refer to paragraph 9-8.e.

9-139.f. Emergency Turn-Off

Refer to paragraph 9-8.f.

9-139.g. Method of Presentation

Refer to paragraph 9-8.g.

9-140. CHAPTER 4.
SCHEDULED
MAINTENANCE

Chapter 4. Scheduled Maintenance

Divide this chapter into three sections as follows:

- a. Section I. Introduction
- b. Section II. Tools and Equipment
- c. Section III. Scheduled Maintenance.

9-141. SECTION I.
INTRODUCTION

Section I explains the scope of the chapter and the kinds of services to be performed. This level of maintenance involves such services as:

- a. Major overhaul and complete rebuilding of parts, subassemblies, assemblies, or end items.
- b. Repair of items requiring special environmental facilities.
- c. Nondestructive testing of removed parts.
- d. Special inspection and modification of equipment.
- e. Provisioning of manufacturing items and parts not stocked in the supply system.

9-142. SECTION II.
TOOLS AND
EQUIPMENT

Section II specifies the tools and equipment to be issued to depot support maintenance personnel. List electronic test equipment by Joint Army-Navy (JAN) nomenclature. List other items by the proper Cataloging Handbook nomenclature. Provide illustrations showing the use of any tools or equipment used in a special way for

adjustment or calibration. Include these illustrations at the point where the instruction is given.

Section III contains scheduled maintenance procedures in the form of maintenance check-off and performance standards. Coordinate with the Procuring Activity in preparing this information for the technical manual. Format this information, as follows:

**9-143. SECTION III.
SCHEDULED
MAINTENANCE**

- a. Scheduled Maintenance Action Index. This index is used to specify scheduled performance tests and preventive maintenance procedures. Tabulate the index as follows (see figure 5-12):

**9-143.a. Scheduled
Maintenance
Action Index**

- (1) Column 1, Interval. Provide an alphanumeric list of all maintenance actions contained in the chapter. Use the following interval symbols, as appropriate, in the order of increasing interval, as listed below:

<u>Interval</u>	<u>Symbols</u>
Hourly	H
Daily	D
Weekly	W
Monthly	M
Quarterly (3 months)	Q
Semiannually (6 months)	S
Annually (12 months)	A
Overhaul cycle	C
As specified (explain circumstances)	R ¹

¹Precede an R interval by a recommended calendar interval, e.g., daily as specified (DR), weekly as specified (WR), etc.

(2) Column 2, Maintenance Action. List the maintenance action which corresponds to the interval number in column 1.

(3) Column 3, Reference. State the paragraph or table number of the maintenance procedure that corresponds to the maintenance action in column 2.

**9-143.b. Scheduled
Maintenance
Procedures**

b. Scheduled Maintenance Procedures. Include the information required to inspect, clean, and lubricate the equipment. State the following, as applicable:

(1) Safety precautions.

(2) Tools, parts, materials, and test equipment.

(3) Cleaning solvents. Use government specification numbers and federal stock numbers to identify.

(4) Instructions for properly maintaining all safety devices and interlocks, with warnings and cautions.

(5) Instructions for lubrication at operating temperatures, and types and quantities of lubricants to be applied. Use government specification numbers and federal stock numbers to identify lubricants. Include specific lubricants for arctic or tropic environments. When a proprietary lubricant is approved, list a government specification lubricant as an emergency substitute.

(6) Procedures for obtaining access to subassemblies or subcomponents.

(7) Instructions for in-place balancing and noise reduction.

- (8) Inspection procedures for parts which deteriorate due to cycles of use, age, or climatic conditions.
- (9) Illustrations to identify lubrication points and other pertinent data.
- (10) Other information pertinent to these procedures.

c. Scheduled Performance Tests. Provide step-by-step procedures necessary to verify that the equipment is operating within standards in all modes of operation. Include the following:

**9-143.c. Scheduled
Performance
Tests**

- (1) Safety precautions.
- (2) List of tools and test equipment identified by type, manufacturer, and model number.
- (3) Title of the test to be performed.
- (4) Preliminary set-up data required to perform the test.
- (5) Detailed procedures for accomplishing the test. Procedures requiring lengthy and identical set-up data may be presented in detail in one procedure and referenced in succeeding procedures.
- (6) Values or conditions, with tolerances, indicative of normal operation.

Chapter 5. Troubleshooting

Refer to paragraph 9-36.

**9-144. CHAPTER 5.
TROUBLE-
SHOOTING**

Chapter 6. Corrective Maintenance (Less Depot)

Refer to paragraph 9-37.

**9-145. CHAPTER 6.
CORRECTIVE
MAINTENANCE
(LESS DEPOT)**

**9-146. SECTION I.
INTRODUCTION**

Refer to paragraph 9-38.

**9-147. SECTION II.
ADJUSTMENTS AND
ALIGNMENTS**

Refer to paragraph 9-39.

**9-148. SECTION III.
REPAIR**

Refer to paragraph 9-40.

**9-149. SUPPORTING
ILLUSTRATIONS
AND DATA**

Refer to paragraph 9-41.

**9-150. CHAPTER 7.
DEPOT
MAINTENANCE/
OVERHAUL
INSTRUCTIONS**

Chapter 7. Depot Maintenance/Overhaul Instructions

Major overhaul or complete rebuilding of parts, subassemblies, assemblies, or the end item are performed by depot maintenance. This is accomplished using the IROAN (Inspect and Repair Only as Necessary) approach. Depot maintenance normally supports the supply function by rebuilding and returning to stock on a scheduled basis. Depot and commercial maintenance is included in fifth echelon maintenance. Divide the chapter on depot maintenance into four sections as follows:

- a. Section I. General
- b. Section II. Tools and Equipment
- c. Section III. General Inspection
- d. Section IV. Overhaul Procedures.

**9-151. SECTION I.
GENERAL**

This section contains three major paragraphs:

- a. Scope. This paragraph presents the scope of instructions included in this chapter. The instructions provided will assist depot maintenance personnel in the complete overhaul (rebuild) of equipment. Include the following standard paragraph in the manual.

"The following instructions are provided for the use of depot maintenance personnel. They contain information on the maintenance of (insert short name of item) which is beyond the scope of the tools, equipment, personnel, or supplies normally available to lower echelon maintenance facilities."

- b. General Information. This chapter contains instructions required to adjust and align the equipment and to remove, repair, reinstall, and align all repairable parts, modules, subassemblies, and assemblies. In the instructions identify the action to be accomplished; safety precautions to be observed; and tools, parts, material, and test equipment required. Also identify preliminary control settings; test equipment set-up instructions; and step-by-step instructions, with supporting illustrations, to accomplish the maintenance task.
- c. Instructions. Include all data on the equipment, its accessories, and auxiliaries which are pertinent to the depot maintenance facilities covered and not included in other parts of the manual. This data will include:

9-151.a. Scope

**9-151.b. General
Information**

9-151.c. Instructions

- (1) Classification and rating information of main components and auxiliaries.
- (2) Repair and Replacement Standards for ready reference on all assemblies.
- (3) Installation clearances with maximum allowable clearance, adjustment, and alignment clearances, and similar data.
- (4) Charts showing Time Standards for higher echelon work on the equipment, such as time required to remove and replace major assemblies, minor assemblies, major and minor parts, common hardware, and all procedures required in the repair and rebuilding of the equipment.

**9-152. SECTION II.
TOOLS AND
EQUIPMENT**

This section covers tools and equipment over and above those available to lower echelons of maintenance that are supplied to depot for equipment overhaul. Standard and commonly used tools and equipment are authorized for issue by tables of allowances and tables of equipment and need not be covered here. This section contains two major paragraphs as follows:

**9-152.a. Special Tools
and Equipment**

- a. Special Tools and Equipment. Special tools are those issued and designed for a specific function on one type of equipment. Special tools may also include common tools required by the operator for day-to-day maintenance. If a common tool is used in a lower echelon and is obtained through normal supply channels, it is classed as a special tool. Special tools may also be those tools required or desired to perform fifth echelon maintenance for which no requirement exists at a lower echelon. In this section, discuss special tools and equipment required to perform the repair operations described in the manual. Provide any other information about special tools or equipment

such as referenced or specific instructions for their use. If no special tools are required, note this fact in the paragraph. If special tools or equipment are required for performing the maintenance function, prepare a table (see figure 6-5). In the column designated "Stock Number," provide the National Stock Number (NSN) or Joint Army-Navy (JAN) numbers (for electronic test equipment) for all tools and equipment listed. The following is a sample of the type of information required in a paragraph describing the table:

"The special tools and equipment required to perform the repair and overhaul operations on the (insert short name of item) and accessories are listed in Table 0-0. References and illustrations indicating the use of these tools are listed in the table. The five-digit code preceding the stock number is the Federal Supply Code Number for the manufacturer of the tool(s)."

- b. Fabricated Tools and Equipment. Use the following example paragraph in the manual when it applies to the item of equipment:

"The fabricated tools and equipment, illustrated in figure 0-0, are for use of depot maintenance personnel performing major overhaul work on the (insert short name of item). The tools and equipment listed for use are not available for issue but must be fabricated by qualified depot maintenance personnel."

**9-152.b. Fabricated
Tools and
Equipment**

(If no fabricated tools or equipment are required, note this fact in the manual, and exclude the above paragraph). Also describe and give details such as material dimensions, thread sizes, etc. If only one item of fabricated tools or equipment is required, the information may be presented by an illustration and detailed text (see figure 6-6). The illustration must be a line drawing indicating all pertinent dimensions. If more than one item of fabricated tools or equipment is required, present the information as an illustration and a table. In the table, list the items by figure and paragraph references with brief descriptions of their uses.

9-153. SECTION III.
GENERAL
INSPECTION

Explain why equipment inspections are included in overhaul procedures. Clarify the importance of being able to determine the condition of components, including those leading to possible early failure. Also explain the need for establishing supply and maintenance procedures in an orderly manner. This section contains the following paragraphs:

9-153.a. Scope

- a. Scope. Briefly describe the extent of technical inspections to be performed by depot maintenance personnel. Define pre-overhaul inspection, in-process inspection to be performed during overhaul, and final inspection after overhaul has been completed.

9-153.b. Categories of
Inspection

- b. Categories of Inspection. The manual must include fully developed discussions on the following three categories of inspection:

- (1) Pre-Overhaul. This inspection is made upon receipt of an item at a depot for overhaul and prior to the start of overhaul procedures. It establishes the initial requirement for replacement parts, schedules the equipment items introduced into the shop workload, and estimates the extent of overhaul required. In these instructions, reference paragraph 9-151.c "Time Standards" in order to establish the total man hours required to accomplish the procedures indicated in the pre-overhaul inspection.
- (2) In-Process. In-process inspection is the quality control inspection of performance and minimum acceptable standards throughout. This inspection is a continuing process during the overhaul of the equipment. It is designed to ensure that all replacement parts conform to the prescribed standards. It also ensures workmanship is in accordance with approved methods and procedures. In these instructions reference the data and standards presented in paragraph 9-151.c.
- (3) Final. Final inspection is that minimum performance, acceptable inspection gained by final test of an end item. This inspection is made upon completion of the overhaul procedures. It is performed by experienced personnel to ensure that the equipment is acceptable in accordance with the performance data and with the equipment's functional specifications.

**9-154. SECTION IV.
OVERHAUL
PROCEDURES**

This section contains the information and procedures required to perform all necessary adjustments and alignments as follows:

- a. Non-operator tuning and adjustment.
- b. Alignments requiring external jigs, test equipment, or bench set-ups.
- c. Alignments that are accomplished after a repair or replacement of a part or module.
- d. Test equipment set-up and other illustrations necessary to support the procedures.

Do not include obvious repair actions such as soldering, use of multimeters, hand tools, etc., except where these actions involve hazards to personnel or equipment. Arrange repair procedures in numeric-alpha unit designation order of the equipment. Support technique and procedure outlined in the text with illustrations depicting removal points, disassembly techniques, components, and areas of components requiring cleaning and inspection. Also depict measurement procedures for the determination of wear, repair techniques, reassembly and installation points, and test devices and their operation. The instructions for reassembly and installation must be complete and detailed. Do not use the phrase, "Reassemble and install in the reverse order of removal and disassembly." Use the following format to present instructions required by succeeding paragraphs of this section:

- 0-0 (Item name) Removal and Disassembly.
- 0-0 (Item name) Cleaning and Inspection.
- 0-0 (Item name) Repair and Replacement.
- 0-0 (Item name) Lubrication.
- 0-0 (Item name) Reassembly and Installation.
- 0-0 (Item name) Test Operation.

Repeat this sequence, as applicable, for each component of the end item. Use only pertinent items. For example, do not use disassembly for those items maintained by complete component replacement (fan belts, thermostats, condensers, vacuum tubes, and the like). Use lubrication only for components requiring it. Repeat the instruction for each component or assembly subject to overhaul procedures.

- a. Removal. Present detailed, illustrated instructions for step-by-step procedures required to remove the subject component from the end item. Include instructions to tag critical parts requiring special handling and to scribe matching surfaces in cases where it is possible to improperly install a component during installation. Do not repeat instructions for any removal procedures presented in previous chapters of the manual or other manuals. Incorporate those procedures here by reference to the applicable text. Care should be exercised in covering the requirements in this paragraph for special or fabricated tools.
- b. Disassembly. Present detailed, illustrated instructions for the step-by-step procedures required to completely disassemble the subject component. Include instructions to tag critical parts requiring special handling, to scribe matching surfaces in cases where it is possible to improperly install a part during reassembly, and to use containers to store very small parts that could be misplaced or lost. Care should be exercised in covering requirements in this paragraph for special or fabricated tools.

9-154.a. Removal**9-154.b. Disassembly**

9-154.c. Cleaning

- c. Cleaning. Present instructions for proper cleaning procedures using approved cleaning agents. The procedures and the agents will differ widely in manuals covering different types of equipment. For example, steam cleaning and vapor baths will be used in cleaning machinery and heavy machinery parts. The same methods would obviously be damaging to items having fabric, leather, rubber, or those compositions usually incorporated in electrical and electronic devices. For each type or composition of components, an individual type of cleaning agent should be recommended. It will be the responsibility of the contractor to research the appropriate Federal and Military documents in order to accurately specify the approved cleaning agent for the specific application. The phrase "using an approved solvent" is not definitive to a degree desirable or even useful in a military manual. The manual will frequently be used in situations and locations where the time to research, and the source material with which to research, the "approved solvent" are non-existent. In addition to prescribing the proper cleaning agent, this paragraph must contain detailed, illustrated instructions for any required cleaning methods that are unique. It is not necessary to illustrate normal cleaning procedures.

9-154.d. Inspection

- d. Inspection. Describe the inspection to be accomplished. Include references to tolerance and wear limit data in 9-151.c and performance standards for electronic equipment. Illustrate the use of special or fabricated tools, if any. Cover in detail the use of precision instruments such as meters, scopes, signal generators, and mechanical measuring devices.

e. Repair and Replacement. Include instructions for the repair of those components which depot maintenance personnel can perform. All repair techniques must be thoroughly described. Those of a complex nature, such as electronic printed circuits, must be illustrated. Do not illustrate common shop procedures such as commutator undercutting, thread chasing, radiator brazing, and leak testing. However, these procedures must be adequately covered in the text. Repair and replacement standards presented in paragraph 9-151.c should be freely referenced in this paragraph. Any replacement technique of a difficult or complex nature must be covered in detail. In simple unit component replacement, merely state "Replace the (unit component) with a like, serviceable item."

f. Lubrication. Cover those lubrication procedures involved in equipment rebuild. Explain that:

- (1) Complete lubrication, in accordance with the lubrication instruction for the specific item of equipment, must be accomplished after reassembly and before operation.
- (2) Those components requiring lubrications of mating surfaces, and which have been cleaned prior to inspection, should be lubricated before reassembly.
- (3) Bearings of the ball or roller type should be repacked at this time.
- (4) All shafts, sleeves, and other components which operate in close tolerance with other surfaces should be coated with a film of the proper lubricant.

9-154.e. Repair and Replacement

9-154.f. Lubrication

9-154.g. Reassembly

- g. Reassembly. Present complete, detailed, step-by-step reassembly instructions. Illustrations used to explain disassembly procedures should be referred to in presenting reassembly instructions. Where jigs, fixtures, presses, and the like are required to put back together assemblies and subassemblies, illustrate their use to the extent required for clarity of instruction. Carefully call attention to those items which have been tagged during disassembly for special handling as well as those items whose matching surfaces have been scribed for guidance in proper positioning during reassembly. Reference nut and bolt torque data as well as clearance, adjustment, and alignment data presented in paragraphs 9-151.b. and 9-151.c.

9-154.h. Installation

- h. Installation. Present installation procedures for all components treated in the removal instructions. The sequence of instructions in this paragraph is very important. Care must be taken that the instructions are not contradictory to, or inconsistent with, any other instructions throughout the manual. Items which were tagged during removal for special handling, and items whose matching surfaces were scribed before removal to prevent improper positioning during installation, must be covered by appropriate instructions.

9-154.i. Operation

- i. Operation. Present instructions here for operation of the end item after overhaul. Include precautions concerning the readings of all instruments and meters and the operation of all controls. Advise on specific indications of deficiencies to observe, such as strange noises, evidence of improper voltages, currents pressures, temperatures, binding of parts which should operate freely, and so on.

- j. Test. The instructions in this part should include references to the performance data listed in paragraph 9-151.c. Stress the IROAN concept that overhaul of an end item is aimed at returning the equipment to new condition. Give specific instructions on performance tests required to control the quality of overhaul maintenance procedures.

9-154.j. Test**Chapter 8. Repair Parts List (If Applicable)****9-155. CHAPTER 8.
REPAIR PARTS
LIST (IF
APPLICABLE)**

Refer to paragraph 5-34.

**9-156. SECTION I.
ITEM IDENTIFI-
CATION LISTING**

Refer to paragraph 5-35.a.

9-156.a. Item Number

Refer to paragraph 5-35.b.

9-156.b. Model

Refer to paragraph 5-35.c.

9-156.c. Stock Number

Refer to paragraph 5-35.d.

**9-156.d. Reference
Designator**

Refer to paragraph 5-35.e.

**9-156.e. Indenture
Code**

Refer to paragraph 5-35.f.

**9-156.f. Item
Identification**

Refer to paragraph 5-35.g.

**9-156.g. Unit of
Measure**

Refer to paragraph 5-35.h.

9-156.h. Quantity

Refer to paragraph 5-35.i.

**9-156.i. Source
Maintenance
Recoverability
Code**

Refer to paragraph 5-35.j.

**9-156.j. Special Stockage
Indicator Code**

9-156.k. Replacement Factor	Refer to paragraph 5-35.k.
9-157. SECTION II. ITEM NUMBER CROSS-REFERENCE	Refer to paragraph 5-36.
9-158. SECTION III. NATIONAL STOCK NUMBER CROSS-REFERENCE	Refer to paragraph 5-37.
9-159. SECTION IV. PART NUMBER CROSS-REFERENCE	Refer to paragraph 5-38.
9-160. SECTION V. CIRCUIT SYMBOL NUMBER TO ITEM NUMBER CROSS-REFERENCE	Refer to paragraph 5-39.
9-161. ASSEMBLY/ SUBASSEMBLY ILLUSTRATIONS	Refer to paragraph 5-40.
9-161.a. Callouts	Refer to paragraph 5-40.a.
9-161.b. Exploded Views	Refer to paragraph 5-40.b.
9-161.c. Line Drawings and Photographs	Refer to paragraph 5-40.c.
9-161.d. Printed Circuit Board	Refer to paragraph 5-40.d.

Appendix**9-162. APPENDIX**

Include appendices, as applicable, to identify appropriate related technical information and procedures (exclusive of administrative procedures).

Index**9-163. INDEX**

Prepare an alphabetical index when the number of paragraphs exceeds 100. (See figure 5-35.)

**TECHNICAL CONTENT -20, -23, -24, -30, -34, and -40
MAINTENANCE MANUALS**

The arrangement of the technical content for -20, -23, -24, -30, -34, and -40 maintenance manuals is similar; therefore, one technical content format for the manuals is provided below. The -20 manual describes the maintenance to be performed by organizational personnel (second echelon). The -23 and -24 manuals describe the maintenance to be performed by organizational and intermediate maintenance personnel (second and third echelons and second, third, and fourth echelons respectively). The -30 and -34 manuals describe the maintenance to be performed by intermediate maintenance personnel (third echelon, and third and fourth echelons respectively). The -40 manual describes the maintenance to be performed by intermediate (fourth echelon) maintenance personnel.

Arrange the technical contents of the respective manual as follows:

**9-164. CHAPTER
HEADINGS**

- a. Chapter 1. General Information and Safety Precautions
- b. Chapter 2. Installation
- c. Chapter 3. Scheduled Maintenance
- d. Chapter 4. Troubleshooting
- e. Chapter 5. Corrective Maintenance
- f. Chapter 6. Repair Parts List (If Applicable)
- g. Appendix A. Related Technical Information and Procedures (exclusive of administrative procedures).

Chapter 1. General Information and Safety Precautions

**9-165. CHAPTER 1.
GENERAL
INFORMATION
AND
SAFETY
PRECAUTIONS**

Refer to paragraph 9-2.

9-166.	SECTION I. INTRODUCTION	Refer to paragraph 9-3.
9-167.	SECTION II. EQUIPMENT DESCRIPTION	Refer to paragraph 9-4.
9-167.a.	Equipment Illustration	Refer to paragraph 9-4.a.
9-167.b.	Reference Data	Refer to paragraph 9-4.b.
9-167.c.	Equipment, Accessories, and Documents Supplied	Refer to paragraph 9-4.c.
9-168.	RELATED ITEMS NOT SUPPLIED	Refer to paragraph 9-5.
9-169.	CHAPTER 2. INSTALLATION	Chapter 2. Installation Refer to paragraph 9-20.
9-170.	SITE SELECTION	Refer to paragraph 9-21.
9-171.	REFERENCE PUBLICATIONS	Refer to paragraph 9-22.
9-172.	TOOLS AND MATERIALS REQUIRED	Refer to paragraph 9-23.
9-173.	UNPACKING AND REPACKING	Refer to paragraph 9-24.

Refer to paragraph 9-25.

**9-174. FOUNDATION
PREPARATION**

Refer to paragraph 9-26.

**9-175. INPUT
REQUIREMENTS**

Refer to paragraph 9-27.

**9-176. INSTALLATION
PROCEDURES**

Refer to paragraph 9-28.

**9-177. INSTALLATION
CHECKOUT**

Refer to paragraph 9-28.a.

**9-177.a. Phase 1.
Installation,
Inspection, and
Pre-Energizing
Procedures**

Refer to paragraph 9-28.b.

**9-177.b. Phase 2. Initial
Turn-On and
Preliminary Tests**

Refer to paragraph 9-28.c.

**9-177.c. Phase 3.
Installation
Verification Tests**

Chapter 3. Scheduled Maintenance

**9-178. CHAPTER 3.
SCHEDULED
MAINTENANCE**

Refer to paragraph 9-32.

**9-179. SECTION I.
INTRODUCTION**

Refer to paragraph 9-33.

Refer to paragraph 9-34.

**9-180. SECTION II.
TOOLS AND
EQUIPMENT**

9-181.	SECTION III. SCHEDULED MAINTENANCE	Refer to paragraph 9-35.
9-181.a.	Scheduled Maintenance Action Index	Refer to paragraph 9-35.a.
9-181.b.	Scheduled Maintenance Procedures	Refer to paragraph 9-35.b.
9-181.c.	Scheduled Performance Tests	Refer to paragraph 9-35.c.
9-182.	CHAPTER 4. TROUBLESHOOTING	Chapter 4. Troubleshooting Refer to paragraph 9-36.
9-183.	CHAPTER 5. CORRECTIVE MAINTENANCE	Chapter 5. Corrective Maintenance Refer to paragraph 9-37.
9-184.	SECTION I. INTRODUCTION	Refer to paragraph 9-38.
9-185.	SECTION II. ADJUSTMENTS AND ALIGNMENTS	Refer to paragraph 9-39.
9-186.	SECTION III. REPAIR	Refer to paragraph 9-40.
9-187.	SUPPORTING ILLUSTRATIONS AND DATA	Refer to paragraph 9-41.

Chapter 6. Repair Parts List (If Applicable)	9-188. CHAPTER 6. REPAIR PARTS LIST (IF APPLICABLE)
Refer to paragraph 5-34.	
Refer to paragraph 5-35.	9-189. SECTION I. ITEM IDENTIFICATION LISTING
Refer to paragraph 5-35.a.	9-189.a. Item Number
Refer to paragraph 5-35.b.	9-189.b. Model
Refer to paragraph 5-35.c.	9-189.c. Stock Number
Refer to paragraph 5-35.d.	9-189.d. Reference Designator
Refer to paragraph 5-35.e.	9-189.e. Indenture Code
Refer to paragraph 5-35.f.	9-189.f. Item Identification
Refer to paragraph 5-35.g.	9-189.g. Unit of Measure
Refer to paragraph 5-35.h.	9-189.h. Quantity
Refer to paragraph 5-35.i.	9-189.i. Source Maint- enance Recover- ability Code
Refer to paragraph 5-35.j.	9-189.j. Special Stockage Indicator Code
Refer to paragraph 5-35.k.	9-189.k. Replacement Factor
Refer to paragraph 5-36.	9-190. SECTION II. ITEM NUMBER CROSS-REFERENCE
Refer to paragraph 5-37.	9-191. SECTION III. NATIONAL STOCK NUMBER CROSS- REFERENCE

9-192. **SECTION IV.** Refer to paragraph 5-38.
PART NUMBER
CROSS-REFERENCE

9-193. **SECTION V.** Refer to paragraph 5-39.
CIRCUIT
SYMBOL NUMBER
TO ITEM NUMBER CROSS-
REFERENCE

9-194. **ASSEMBLY/** Refer to paragraph 5-40.
SUBASSEMBLY
ILLUSTRATIONS

9-194.a. **Callouts** Refer to paragraph 5-40.a.

9-194.b. **Exploded Views** Refer to paragraph 5-40.b.

9-194.c. **Line Drawings and** Refer to paragraph 5-40.c.
Photographs

9-194.d. **Printed Circuit Board** Refer to paragraph 5-40.d.

9-195. **APPENDIX** **Appendix**

Include appendices, as applicable, to identify appropriate related technical information and procedures (exclusive of administrative procedures).

9-196. **INDEX** **Index**

Prepare an alphabetical index when the number of paragraphs exceed 100. See figure 5-35.

PART X. APPENDICES
APPENDIX A. READABILITY SUPPLEMENT

Consult the client agency if the contract does not contain specific information on the reading level at which the manual should be written. As a general rule, sentence length should not exceed 17 words.

Use the procedure below to determine the size of the sample to be analyzed for readability.

A-1. SAMPLE SIZE

- a. Count the number of pages of text in publication.
The count must include all full and partial pages that contain text in the form of consecutive sentences. Do not include pages containing only illustrations, tables, lists, etc. Record the number of text pages.
- b. The basic number of samples is determined by the following:

Number of Text Pages	Divisor <u>Divide By "N"</u>	Basic Number of Samples	
		<u>Min</u>	<u>Max</u>
90 and above	10	9	30
54 to 89	9	6	9
32 to 53	8	4	6
1 to 31	6	2	4

- c. Divide the number of text pages by the appropriate divisor, "N." Round off quotient to the next lowest whole number. For example, round off quotients of 17.3 and 17.7 to 17. This quotient will equal the basic number of samples to be analyzed.
- d. For publications that are less than 12 pages, randomly select two samples and mark them for analysis.

- e. For publications that are 12 pages or more, randomly select a number between one and "N." The number selected must be marked as the first page of text to be analyzed. Starting at the selected page, mark every "Nth" page of text to the end of the publication. The marked pages must identify starting points for the remaining basic samples to be analyzed.
- f. Check the marked pages to verify that at least one sample has been selected from each chapter of the publication. If any chapter has been missed, randomly select one text page from that chapter and add it to the basic samples to be analyzed.

**A-2. RAW DATA
COLLECTION**

For each sample marked, raw data must be collected. Data collection will consist of counts of the numbers of words, sentences, and syllables in each sample. The size of each sample is based on the number of words to be analyzed.

A-3. WORD COUNT

Most samples will be slightly more than 200 words; in some cases, samples will be smaller. Determine word count samples as follows:

- a. Samples must start at the beginning of the first full paragraph on each marked sample page. If the sample falls on a page containing procedural instructions, start the sample at the beginning of the first full sentence on the page. Do not count headings, captions, and paragraph titles in the sample.
- b. For each sample, count all words up to the end of the sentence containing the 200th word. If the marked sample page is less than 200 words, the sample can be extended to the next page of text.

Do not extend the sample into a new chapter or text pertaining to a completely new subject.

- c. Count as a word all numbers, letters, symbols, and group of letters surrounded by white spaces. Hyphenated words and contractions count as one word. For example, each of the following count as one word: couldn't; GFE; i.e.; 32,008; 19-inch; +25°F.
- d. Record the number of words in each sample.

For each sample, count the number of sentences as follows:

A-4. SENTENCE COUNT

- a. Count all sentences in the sample including the sentence that contains the 200th word.
- b. Count as a sentence each unit of thought that can be considered grammatically independent of another sentence or clause. A period, question mark, exclamation point, and semicolon usually denote independent clauses and mark the end of a sentence.
- c. Record the number of sentences in each sample.

For each sample, determine the number of syllables as follows:

A-5. SYLLABLE COUNT

- a. Count the number of syllables in each word.
- b. Count all numbers as one syllable. For example, "200" and "51" count as one syllable. However, if a numeric expression contains several numbers separated by hyphens, count each number as a syllable. For example, "TM 2-1225-300-10" is counted as four syllables.
- c. Count acronyms and abbreviations as one syllable unless they actually spell out a word of more than

one syllable. For example, "MCDEC" counts as two syllables.

- d. Record the number of syllables in each sample.

A-6. GRADE LEVEL CALCULATIONS

Perform grade level calculations as follows:

A-6.a. Overall Grade Level (OGL)

a. Overall Grade Level (OGL):

- (1) Add up total number of words from all samples combined. Record the total.
- (2) Add up total number of sentences from all samples combined. Record the total.
- (3) Add up total number of syllables from all samples combined. Record the total.
- (4) Calculate the average sentence length. Divide the total number of words by the total number of sentences. Round off the quotient to the nearest one-hundredth. Record the quotient.
- (5) Calculate the average number of syllables per word. Divide the total number of syllables by total number of words. Round off the quotient to the nearest one-hundredth. Record the quotient.
- (6) Calculate the Overall Grade Level (OGL) of publication by the following formula:

$$\text{OGL} = 0.39 (\text{Average words/sentence}) + 11.8 (\text{Average syllables/words}) - 15.59.$$
 Round off the OGL to the nearest one-tenth.

A-6.b. Sample Grade Level

b. Sample Grade Level.

- (1) Calculate the average sentence length. Divide the number of words in the sample by the number of sentences in the sample. Round off the quotient to the nearest one-hundredth.

- (2) Calculate the average number of syllables per word. Divide the number of syllables in the sample by the number of words in the sample. Round off the quotient to the nearest one-hundredth.
- (3) Calculate the Grade Level (GL) of each sample by the following formula:

$$GL = 0.39 (\text{Average words/sentence}) + 11.8 (\text{Average syllables/words}) - 15.59$$
Round off each GL to the nearest one-tenth.

**APPENDIX B. CHAPTER FORMAT SUMMARY ARRANGEMENT
FOR TECHNICAL MANUAL TYPES IA, IB, II, AND III**

CHAPTER TITLES	TYPE MANUAL					
	IA	IB	II	III	CHAPTER NUMBERS	
General Information and Safety Precautions		1		1		
General Information					1	
Safety Precautions					2	
Installation		2		2	3	
Functional Description		3		3	4	
Operation		4		4	5	
Maintenance Procedures		5				
Scheduled Maintenance				5	6	
Troubleshooting		6		6		
Corrective Maintenance		7		7		
Fault Isolation					7	
Alignment Procedures/Corrective Maintenance					8	
Repair Parts List		8		8	9	
General Instructions			1			
Operating Instructions			2			
Corrective Maintenance			3			
Overhaul Instructions			4			

**APPENDIX C. CHAPTER FORMAT SUMMARY ARRANGEMENT
FOR TECHNICAL MANUALS -10 THROUGH -40**

CHAPTER TITLES	TYPE MANUAL										
	-10	-12	-13	-14	-15	-20	-23	-24	-30	-34	-40
	CHAPTER NUMBERS										
General Information and Safety Precautions	1	1	1	1	1	1	1	1	1	1	1
Installation		2	2	2	2	2	2	2	2	2	2
Operating Instructions	2	3	3	3	3						
Scheduled Maintenance	3	4	4	4	4	3	3	3	3	3	3
Troubleshooting		5	5	5	5	4	4	4	4	4	4
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GLOSSARY

Section I. ABBREVIATIONS

ac	Alternating current
ASSEM FR	Assembled from other items
C/O	Consist of
dc	Direct current
DoDISS	Department of Defense Index of Specifications and Standards
FAB FR	Fabricated from other items
Hz	Hertz
IROAN	Inspect and Repair Only as Necessary
JAN	Joint Army-Navy
NSN	National Stock Number
POM	Plus or minus
rf	Radio frequency
RPL	Repair parts list
S/A	Same as
SMR	Source Maintenance Recoverability
USASI	United States of America Standards Institute
VSWR	Voltage standing wave ratio

Section II. DEFINITIONS

Adjust - to regulate periodically in order to prevent malfunction.

Align - to properly position or precisely adjust parts.

Basic manual - the original manual edition.

Cable run diagrams - an isometric diagram which indicates the location of all cable runs between compartments or areas and shows, by deck, compartment, and frame identification, the location of all cables shown on the interconnecting diagrams.

Callout - anything placed on an illustration to aid in identifying the objects being illustrated, such as index numbers, nomenclatures, leadlines, arrows, procedures, and when placed directly on the illustrations, legends (keys).

Cautions - statements in the body of the text to call attention to steps and procedures that must be strictly followed to prevent damage to, or destruction of, equipment.

Change - comprised of corrected pages to the basic manual. Consists of information that improves or clarifies the basic manual without rewriting or reorganizing the technical contents.

Chapter - the first major functional division of a publication.

Commercial manual - a manufacturer's existing manual.

Control cycle diagrams - show the entire cycle on a single, signal flow logic diagram together with an appropriate note describing key operating features.

Control diagrams - group circuits according to energizing voltage, control function, mode of operation, or physical limits of cabinets or assembly.

Corrective maintenance - adjust and align equipment and remove, repair, reinstall, and align all repairable parts, modules, subassemblies, and assemblies.

Depot maintenance - phases normally performed at this level include the repair embracing major overhaul and complete rebuilding of parts, subassemblies, assemblies, or the end items; repair of items requiring special environmental facilities; nondestructive testing of removed parts; special inspection and modification of equipment; and provisions of manufacturing items and parts not stocked in the supply system. Depot maintenance is synonymous with fifth echelon maintenance.

Equipment description - describes the intended use, capabilities, and limitations of the equipment.

Mechanical schematic diagrams - show the operational sequence and arrangement of the mechanical device including electrical control circuits.

Organizational maintenance - phases normally performed at this level consist of inspecting, servicing, lubricating, and adjusting parts, and replacing parts, minor assemblies, and subassemblies not requiring highly technical skills. Organizational maintenance is the responsibility of a using organization and includes first and second maintenance echelons. (See first and second echelons.)

Overhaul - to restore an item to a completely serviceable condition by inspecting, disassembling its assemblies and subassemblies as necessary, replacing parts, and performing necessary boring, grinding, or machining operations, followed by reassembly and final inspection.

Part - the next lower division of a publication below volume.

Piping diagrams - show component interconnections, such as piping, tubing, or hose, and sequential flow in the system.

Pre-overhaul inspection - the inspection made upon receipt of an item at a depot for overhaul prior to the start of overhaul procedures. Designed to establish the initial requirement for replacement parts, to schedule the equipment items introduced into the shop workload, and to estimate the extent of overhaul required.

Preliminary manual - an interim issue that a contractor submits to the client agency for review and approval before developing the final manual.

Preventive maintenance - the systematic inspection of equipment before operation to ensure that the equipment is ready for operation at all times and includes but is not limited to maintenance check-offs and performance standards.

Printed wiring assemblies - assemblies in which conductive, semi-dielectric or magnetic patterns are formed by photo etching, silk screening, stamping, vapor deposit, or similar processes.

USMC STYLE GUIDE

Protective device index - an index including all protective devices such as fuses, circuit breakers, etc.

Power distribution diagrams - depict the distribution of primary ac power, secondary ac power, and dc power from the terminal board, breaker, or fuse box to the various subassemblies or modules of the equipment.

Relay, lamp index - a tabular index for all relay coils and indicator lamps.

Repair - to restore that which is unserviceable to a serviceable condition by adjusting or replacing damaged or unserviceable parts, components, or assemblies.

Repair parts list (RPL) - a list of all parts required to maintain and support the equipment.

Replace - to substitute serviceable assemblies, subassemblies, and parts for unserviceable components.

Replacement factor - Column 11 of the Item Identification Listing which indicates the average rate that the type of item coded has been used by the Marine Corps field units or the rate at which design engineers anticipate the item will fail, wear out, or otherwise require replacement.

Revisions - second or later manual editions and volumes that supersede a previous edition.

Scheduled maintenance - procedures and performance tests conducted on a scheduled or condition monitoring basis.

Scheduled maintenance action index - index used to specify scheduled performance tests and scheduled maintenance procedures.

Scheduled maintenance procedures - information required to inspect, clean, and lubricate the equipment.

Equipment illustration - represents all units comprising the equipment to include the major units of the equipment, relative size of the unit, basic interconnections between units, and relationships of units with other equipment.

Fault logic diagrams - based on a fault indication that may be observed during troubleshooting and comprise a branching series of questions on fault isolation.

Fifth echelon - maintenance performed at a depot which embraces major overhaul or complete rebuilding of parts, subassemblies, or the end item.

Final inspection - the minimum performance acceptance inspection gained by final test of an end item and made upon completion of the overhaul procedures.

First echelon - maintenance performed by the user or operator.

Flow charts - provided for digital devices to support the explanation of machine instructions and test programs.

Fourth echelon - maintenance performed in rear areas by a higher echelon than the maintenance organization directly supporting the using unit, or in some specifically authorized cases, by the using unit.

Functional description - a complete account of the way in which the equipment achieves its objective.

Indenture Code Letters - Column 5 of the Item Identification Listing which indicates the relationship of a line item to an end item or to the preceding component, assembly, or subassembly.

In-process inspection - the quality control inspection of performance and minimum acceptance standards during overhaul. Designed to ensure that all replacement parts conform to the prescribed standards and that the workmanship is in accordance with approved methods and procedures.

Inspect - to verify serviceability and to detect imminent mechanical failure by scrutiny.

Inspect and Repair Only As Necessary (IROAN) - the maintenance technique which determines the minimum repairs necessary to restore equipment, components, or assemblies to prescribed maintenance serviceability standards by using all available diagnostic equipment and test procedures and by minimizing disassembly and parts replacement.

Installation checkout - step-by-step procedures to demonstrate that the equipment operates correctly and within tolerances. A three-phase approach is used for explanation: (1) Installation, Inspection, and Pre-Energizing Procedures, (2) Initial Turn-On and Preliminary Tests, and (3) Installation Verification Tests.

Interconnection diagrams - a block diagram presentation of all cables running between equipment by cable number, the number of active and spare leads in each cable, and all junction boxes, switchboards, etc. into which interconnection cables enter or leave.

Intermediate maintenance - phases performed at this level are normally limited to replacement of parts, subassemblies, and assemblies. Intermediate maintenance is the responsibility of a designated maintenance activity, includes third and fourth maintenance echelons, and may be supported by a higher level echelon of maintenance. (See third and fourth echelons.)

Item Identification Listing - the main part of the repair parts list arranged in columns to show stock numbers, item identification, replacement factors, and other data necessary to maintain the equipment in operative condition.

Logic diagrams - provided for digital devices and digital aspects for conventional equipment.

Maintenance - the action taken to retain material and equipment in, or restore material and equipment to, a serviceable condition.

Maintenance schematic diagrams - depict unit-to-unit interconnection diagrams, intra-unit interconnection diagrams, and unit, assembly, and subassembly schematic diagrams.

Scheduled performance tests - step-by-step procedures necessary to verify that the equipment is operating within standards in all modes of operation.

Second echelon - maintenance performed by specially trained personnel provided for that purpose in the using organization.

Section - the first major functional subdivision of a chapter.

Service - to clean, preserve, and replenish fuel and lubricants.

Signal flow diagrams - detailed block diagrams which illustrate the functional development of each equipment output from its origin to its measurable output.

Signal-function diagrams - logic diagrams for non-programmable devices which result in a unique output function, prepared to the requirements of signal flow diagrams.

Source Maintenance Recoverability (SMR) Codes - Column 9 of the Item Identification Listing which includes a series of alphabetic letters that denote the uniform source, maintenance, and recoverability coding structure. The code is assigned to items subordinate to or associated with an end item.

Special Stockage Indicator Code - Column 10 of the Item Identification Listing which identifies the condition under which certain maintenance parts are stocked.

Supplemental manual - a manual which complements the data provided in a basic manual.

System - two or more equipment sets or major components, each having its own identity and nomenclature, arranged and interconnected to perform a specific function.

System cable interconnection check - coldwire check procedures that verify the proper installation of all system cables.

System data function diagrams - a detailed presentation of the system information needed to isolate faults within signal or data flow paths.

System function directory - a listing which tabulates operator control functions.

System piping run diagrams - an isometric diagram which indicates the location of all system piping runs between compartments and areas, and shows, by deck, compartment, and frame identification, the location of all pipes, valves, fittings, tanks, etc.

Technical manual - publications and other forms of documentation containing a description of equipment, weapons, or weapon systems, with instructions covering initial preparation for use; operational instructions; maintenance instructions; overhaul instructions; parts list or parts breakdown; and related technical information exclusive of administrative procedures.

Test - to verify serviceability and to detect imminent mechanical or electrical failure by use of special equipment such as gauges, meters, etc.

Third echelon - maintenance performed in direct support of, or in some specifically authorized cases by, the using unit.

Timing circuit diagrams - show the exact timing relationships and the origins of all timing signals (conventional and digital).

Troubleshooting - the process of locating equipment malfunctions and conducting tests on each component, assembly, or subassembly of the equipment so that repairs and adjustments can be made.

Troubleshooting-Maintenance Dependency-Matrix Chart - identifies the functional dependency of output signals or indications upon circuit elements, circuits, modules, etc.

Utilities list - a list that presents in tabular form all utilities required and the quantities in each system, compartment, and area.

Volume - the first separately bound subdivision of a publication.

Warnings - statements in the body of the text to call attention to steps and procedures that must be strictly followed to prevent serious injury or death to personnel.

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